THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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INSTITUTION PROCEEDINGS.

THE announcement made by Dr. Glazebrook in vacating the presidential chair of the Institution, that Lady Kelvin was making good progress towards complete restoration of health, will be received with gratification by the whole of the electrical profession, which has been watching with extreme concern the trial through which Lord Kelvin, the father of the profession, has lately passed. The new President further expressed, through the mouth of Dr. Glazebrook, his regret that he was prevented from being present, and his hope that he would be able to attend before the end of the session.

In his response to the usual vote of thanks, Dr. Glazebrook made two other announcements of exceptional interest and significance. The first was to the effect that arrangements had been made whereby co-operation would be established between headquarters and the Local Sections of the Institution in the selection of papers. Hitherto the Local Sections have acted practically with entire independence in this respect; their papers, when read, were sent up to headquarters and a selection made for publication in the *Journal*, but otherwise, with the exception of one or two papers read first at a Local Section and afterwards in London, there has been no co-operation. In future all papers received will go before a Papers Committee, composed of representatives of the Local Sections and of the Council, which will select those which should be read in London. Endeavours will be made to read and discuss these papers also at the Local Sections simultaneously or nearly so, thus focusing the attention of the whole Institution on one paper.

By this means, we take it, the Council hopes to restore the prestige of the London meetings, which for a long time past has suffered considerably by comparison with the work of certain of the Local Sections. So long ago as 1902, we drew attention to this danger in the following words:—

"We note with regret the falling off in quality of the papers selected by the Council for the edification of the members of the 'London Local Section,' so to speak, when they are compared with the really excellent papers which have been read at Glasgow and Manchester. Why does not the Council exercise some discrimination? . . . Is it possible that the Council has no option—that better papers are not *offered?* . . . Let fewer be chosen—and better—leaving due time for the discussions; or, what is far better, let them be read in abstract, and let those who take the trouble to read the full text in advance be rewarded by a share in the discussion."

It will be seen that by the new system the London meetings will be enabled to hear and discuss the pick of the papers, and that the possibility of their being outshone by the Local Sections in this respect is effectually removed; this result may not be altogether palatable to the latter, but it will probably, as Dr. Glazebrook suggested, strengthen the Institution as a whole, and will greatly help the weaker

sections. The effect on the discussions will be watched with interest—in this respect the London meetings stand to lose.

As will be seen from the foregoing quotation, we advocated the reading of papers in abstract five years ago, and we have repeated the suggestion at intervals since then. We also urged that the minutes of previous meetings should be taken as read; this is now done, and we heard with much pleasure Dr. Glazebrook's second announcement, that in future all papers would be read in abstract. We trust that, as an essential part of this procedure, advance copies of the papers will be forwarded to every member in time to allow of their being read and digested before the meeting, so that a good discussion may be ensured.

We had almost given up hope that amendment would be effected in the procedure of the Institution; but, seeing that so much has at last been done, our hopes revive that it may become of ever-increasing value to the industry of which it is at the head.

Electrical Exhibitions in 1908.

In our issue of August 30th, in replying to a correspondent, we remarked:—"It may be that there is a reasonable need for electrical exhibitions both at Manchester and in London, but that is hardly a practicable course for next year. Manufacturers cannot be effectively represented at both places at one and the same time, nor, in their present state of mind, are they likely to try to be. But if there is a strong feeling in the Manufacturers' Association in favour of an exhibition in London, why does that feeling not take a definite shape?"

The doubt that we expressed in the above comments has been turned by recent events into a clear conviction that there is no appreciable desire for an electrical exhibition to be held in London in 1908 either with or without the guidance of the Manufacturers' Association.

The firm of exhibition managers who had so much to do with the 1905 Exhibition at Olympia, took upon themselves to test how strong or how weak the feeling in the trade was. Along with the general body of 1905 exhibitors, and an indefinite number of others, we received an invitation to attend a meeting to be held at the Holborn Restaurant on Thursday last week to discuss the matter. The gathering was of too little importance to justify our occupying space with any detailed account of what transpired. But it is due to the members of the trade who were invited that they should be informed that, after an hour and a half's across-the-table talk—most of it for enlightening the promoters of the meeting concerning the progress that is being made with the Manchester Exhibition and with the arrangements for the Franco-British Show—Messrs. Smith and Bridges had the good sense to announce the withdrawal of the suggestion contained in their circular, that an electrical exhibition should be held at Olympia next year.

The enthusiasm in favour of the idea was such that 11 or 12 firms, more or less in the electrical trade, sent representatives. The majority of these were there merely to watch and not to express any views one way or the other. One spoke plainly in favour of London, and one did not seem to think that any exhibitions at all were wanted. A few firms sent their opinions by letter. If the meeting had no other result, it must have strongly impressed upon Messrs. Smith and Bridges the fact that an electrical exhibition at Olympia next year is certainly not wanted by any considerable section of the electrical trade.

The Manchester electrical exhibition movement is making considerable headway. It is true that certain firms have intimated that they will not be prepared to show thereat. That is a matter for them to settle individually—a detail in the internal conduct of their own businesses in which nobody else has any right or desire to intermeddle. It may be that some of them are anxious to exhibit in London—well, they will have their opportunity at Shepherd's Bush in the eyes of the public for a full half-year; whether it will be worth their while is quite another matter and depends upon many things, amongst them being, first, the actual character of the electrical display, about which nobody seems to know anything at present; and secondly, the class of wares that particular firms may have to show. It is our belief that in the main they will have to be of a kind that will appeal to the popular fancy, making an advertisement impression upon the public mind which may or may not bear fruit. But in regard to that we may be better able to speak when the Electrical Committee is in a position to publish its plans, whatever they may be. At the moment we see no reason to unsay what appeared in our issue of August 23rd, which was in effect that the electrical trade would not find it a profitable undertaking to seriously display at a pleasure show, however worthy the object of the latter might be from the point of view of international politics.

A Tale of a Surplus.

It is with a certain amount of compunction that we refer to yet another glaring inaccuracy on the part of a journal devoted to the gas and oil interest.

Our contemporary, exhilarated by a visit to the recent Manchester Gas Exhibition, plumes itself—possibly both tar and feathers adhered during the visit—on the usefulness of such a specialised exhibition, as well as on the financially healthy position of the gas industry.

Now, we do not dispute the possibility of the gas industry's being overburdened by hard cash surpluses, thanks to the tar and other by-products, but nothing less than a seat in the present Government will enable us to swallow the statement that Manchester's gas undertaking "contributes something like £60,000 a year to the General Corporation Fund in order to help along the electricity, and other less remunerative departments."

As to what this statement exactly means, we can only surmise, but a reference to our analysis of Manchester's electricity accounts for the past three years, shows that the affairs of that department have certainly not called for any lavish generosity on the part of another department.

The essential items of the electricity returns were as follows:—

	1905.	1906.	1907.
Gross profit	£166,208	£188,082	£201,744
Interest on l ans, &c. ...	64,144	65,333	65,958
Sinking fund	59,192	66,543	69,519
Renewals account ...	38,328	40,000	40,000
Net surplus	4,544	16,206	26,267

We are, of course, fully aware that these returns show a lack of philanthropic donations to the rates—so dear to many municipal enthusiasts—even to a total disregard of music in the parks and other praiseworthy objects. The surplus has been consistently placed to reserve, and we venture to suggest that this course is an eminently satisfactory one. As the tramways department, although somewhat electrically inclined, is quite beyond criticism—having charitably disposed of upwards of £50,000 per annum during the past three years—we shall be glad to know, for the sake of the Electrical Department, exactly whose pocket does benefit by the Gas Committee's donations.

Misleading editorial statements, even when based on the exuberant utterance of a Gas Committee, recovering from the effect of a gas exhibition, have no justification; the Electricity Department's accounts are obtainable in black and white, and the solemn twaddle which obtains such prominence in our contemporary, misleads few.

Packing for Export.

The packing of machinery and apparatus must become increasingly important as greater attention is paid by our manufacturers to export electrical trading. Every man knows how annoying it is to receive at his residence or office broken goods of one kind or another, which need not have been broken had reasonable

care been devoted to the packing of them before despatch. The fretting annoyance of correspondence and delays consequent thereupon, does not incline the purchaser in favour of the delinquent. And in the larger sphere of foreign trade where weeks and months of waiting may be occasioned by some broken essential part, quite trivial in its dimensions and cost, the same annoyance is occasioned, only it is far more serious. We do not desire to make any statement depreciatory of the British manufacturers' packing methods, for as we read it he is no worse than his rivals—indeed, if we could get at the real truth of the whole matter, we should not wonder if the percentage of British error in proportion to the volume of business done were comparatively lower. We have not lost our reputation for efficiency in manufacture, and we have packed machinery and other stuff for export for so long a period that we, if anybody, ought to know how to do it. We are quite aware that Consular reports written by the British representative for consumption in the United Kingdom tell us what a bad lot we are in this respect, but we have also read American Consular reports which speak in the plainest of parental fashions to the American exporter, and tell him that he knows far less about the art of packing and the importance of it than does the British manufacturer. Quite recently an American writer was lecturing his trans-Atlantic readers regarding their shortcomings in terms which would have made us blush had they been addressed to us.

We all know that time and time again urgently required apparatus sent to India, and machinery sent to South America, have reached their destination in such a manner that they might just as well have been at home for all the service they could render for months; and we have also seen cases of machinery, &c., received in this country from the Continent in the same temporarily hopeless condition. We have read the letters of irritated consumers who labour under grievances of this kind, pointing out how serious are the consequences to them, and indulging in those commercial—well, pleasantries—that business correspondence is occasionally known to contain. The effect of all this is not beneficial to the manufacturer or trader who, while looking to the higher departments of his business, leaves the packing department to supervise and run itself, or fails to have in charge thereof good men of experience who are thoroughly skilled in the art of packing, and who are able to appreciate the importance of taking into account the climatic conditions obtaining in transit, and at point of destination. It seems that every nation that exports does some bad packing at times—mistakes will happen, so it is not profitable to waste time in thinking we are not so bad as the other fellow. The better plan is to see that the methods adopted in the packing department are as efficient as we can make them.

Tele-photography.

Our esteemed contemporary, *Electricity and Electrical Engineering*, in its last issue takes exception to the use of this word, saying that it "is a misnomer, because telephotography has been a long time the term employed for denoting the method of photographing distant objects by means of a telephotographic lens," and suggesting instead the word "phototelegraphy." With due respect to our friends, however, we are unable to support this proposition. The shoe is on the other foot. As long ago as March 1st, 1881, when we described Mr. Shelford Bidwell's invention, we used the word "telephotography" to denote the telegraphic transmission of pictures with the aid of the selenium cell. The word is more euphonious than its suggested rival, and is highly appropriate; moreover, "phototelegraphy" more properly denotes telegraphy by means of light, and is, therefore, an inaccurate description of the process in question. The photographers must change their word, if either party must; but as there is no likelihood of confusion, we see no necessity for a change.

London Power Supply.

As is usual at this time of the year, notices of new projects that are to come before Parliamentary Committees during next session are appearing in the *London Gazette*, and in the advertisement columns of some daily newspapers. The most important announcement that has yet caught our attention, is that relating to the future of London's electricity supply. It is proposed to form a Joint Committee of London electric supply companies upon which representatives of the L.C.C. shall also sit, and into membership in which local authorities shall be admitted. This organisation, in connection with which some 17 companies and 16 municipal authorities are named, would be responsible for the electricity supply of London. We give a number of extracts from the Parliamentary application in our "Notes" to-day, from which some idea of the proposals contained in the new scheme may be obtained.

"Regular" Service.

"A chiel's amang you takin' notes —and, faith, he'll prent it!"

We have found it necessary, from time to time, to point out that one of the greatest drawbacks to the commercial development of wireless telegraphy is its lack of secrecy. No better or more striking illustration of this fact could be desired than the communication which we publish to-day, from the pen of Prof. R. A. Fessenden. From his outpost on the coast of Massachusetts, Mr. Fessenden listens to the music of the hemisphere, or, at any rate, of a large part of it, and he knows what the wild (Marconi) waves are saying. And what is the burden of their song?

Low speed, lack of secrecy, atmospheric disturbances—all these we pointed out in our issue of October 4th; but we must confess that we did not anticipate that they would be experienced to so marked an extent as now appears. We have noticed that during the past few weeks the excitement in the daily Press over the extraordinary achievements of the Marconi Co., reflected in more than one of the technical journals, has wholly died out, and that wireless telegraphy is receiving, and attracting, practically no attention. We are now in possession of the explanation of this curious succession of events. The attempt to establish commercial service has been wholly premature. Just as in 1903, when a similar attempt was made, resulting in a complete fiasco, so now in 1907 enthusiasm has outrun discretion, and the trumpetings of a few weeks ago are succeeded by dead silence in the Press.

Such manœuvres are highly calculated to bring unmerited discredit upon that blameless infant, wireless telegraphy, while they do serious injury to the allied art of submarine telegraphy, and give rise to suggestions, which may be baseless, that their motive is financial rather than commercial.

Road Washing by Electricity.—A correspondent writes:—"The first electric machine for the washing of the carriageways of streets and roads has just been placed in service by the authorities having control of the street cleansing department in Berlin. The machine is equipped with two 4-h.p. motors, which are apparently energised from accumulators, as several hours of uninterrupted work are stated to be obtainable from them. According to a statement published by a local newspaper, the machine must be a really marvellous invention. It is able, it is declared, to spray the water and cleanse at the same time; and to dry the cleansed streets whether paved with wood, asphalte, macadam or other road material, whilst the machine also renders the throwing down of gravel unnecessary in many cases. It weighs 5 tons with a load of 2,500 litres of water, and deals with twice the superficial area of road that is possible with ordinary street washing machines. As such a paragon of modern invention is urgently needed in London, it may be expected that an exodus of the 29 borough engineers and surveyors in the metropolis will speedily take place in order to make an examination of this wonderful creation of electrical engineering ingenuity that is now astonishing the population in Berlin."

REGULAR WIRELESS SERVICE BETWEEN AMERICA AND EUROPE.

We have received the following communication from Prof. R. A. Fessenden :—

Brant Rock, Mass., Nov. 4th, 1907.

Sir,

It may be questioned whether any one cause has had so injurious an effect upon the development of wireless telegraphy as the publication, not only in the daily Press, but in technical papers as well, of almost innumerable incorrect, misleading and often absolutely false statements in regard to the results obtained.

The correction of such misstatements by an individual is a peculiarly unpleasant undertaking, for the reason that the action is almost certain to be misconstrued. On the other hand, the fact that such statements have been allowed to go unchallenged has led to, perhaps, even more regrettable misconstruction. In most cases this duty lies in the hands of the technical journals, and in the great majority of cases it is well and judicially done. In cases, however, where the technical journals have not the information at their disposal on which to base a decision, the duty must devolve upon the individual.

Such publications injuriously effect the development of wireless telegraphy in two ways. In the first place, it has resulted in tens of thousands of individuals in straitened circumstances losing their savings, and has brought the whole business into disrepute with the public. In the second place, the exposure of these exaggerated and misleading statements has resulted in a general incredulity, which has hindered the development of the art; first, by the fact that the various governments have under-estimated the real possibilities of the art, and have been led thereby to make such stringent regulations in regard to its operation as to practically suppress commercial working ; and, secondly, by causing the officials of the various cable and telegraph companies—who would, if they understood the true situation, be the very first ones to warmly welcome and assist in the introduction of wireless working—to discredit it, to the future injury of their own stockholders.

For this reason, therefore—*i.e.*, the injury inflicted upon the development of the art, and upon those companies engaged in its legitimate exploitation—I desire to correct a number of misstatements contained in an article entitled "Regular Wireless Service between America and Europe," which appeared in a recent number of a well-known technical journal :—

(1.) The statement that on Friday, October 18th, 14,000 words were transmitted across the Atlantic is incorrect.

A decimal point has been misplaced, the correct number being approximately 1,400. At 5.17 of that date Glace Bay sent message No. 31 as follows :—

Xs [atmospheric disturbances] here. Stand by ten thirty to-morrow. Gd. nite.

Up to 12.23 p.m. Clifden had sent 17 messages, but after that they did not come through very well, and at 2.39 Glace Bay directed Clifden as follows :—

Try 50 words and repeat it twice. Xs bad.

and after Clifden had sent another message at 2.50, Glace Bay instructed Clifden to keep back its messages, and take Glace Bay's.

The length of the messages varied from 88 words, No. 30, addressed to the *Morning Leader*, London, to six words in No. 21, as follows :—

Plenarily, London. By wireless answer.
McCawley.

A number of these messages, of course, were not commercial ; for example, No. 27, as follows :—

Keep back Hearsts messages, and take *our*. Important.

Several messages were sent in foreign languages, for example, an Italian one from Clifden at 9.20, and a 50-word message sent in French, No. 29, at 3.28, as follows :—

Cdn. Cdn. Here French Sp. No. 29, 50 words.
New York to *Matin*, Paris.

Dans nouvelle depeche sur faits ayant provoque envoi escadre et impression Washington concernant envoi correspondant *Sun* dit on demande dans certains milieux pourquoi Government cherche cacher public Americain European fait bien connu du Japan que envoi flotte est advertissment pour Japan montera que nous n'avons pas peur et sommes prets combattre partout 3. 3. Sp. Sp. Import.

Glace Bay commenced sending this at 3.28 p.m., and, after sending it twice, Clifden at 3.52 called up as follows :—

V.V.V. after Japan——? ? ? ?

when Glace Bay repeated the latter part of the message, finally concluding at 4.01 p.m.

(2.) The statement that the work was "admittedly excellent." The general character of the work is partly shown by the above extracts. The transmission varied very considerably. The best work noted was on October 19th, when at 2.55 p.m. the following message was sent by Clifden :—

Marconi. Congratulate you warmly on successful transmission of wireless telegrams across the Atlantic.
Sidney Buxton.

It was sent twice from 2.55 to 3·05, and the following reply was sent twice by Glace Bay, from 3.09 to 3.17.

To Post Master General, London.
By wireless across the Atlantic I thank you most sincerely for your kind telegram just received by same medium.
Marconi.

This message and its reply took 22 minutes and contained 38 words exclusive of the service words, or 54 including these.

Quite a number of messages had to be repeated half a dozen or more times ; for example, message No. 21 on October 18th, as follows :—

To Louisvient, London,
Shaughnessy interviewed Vancouver. Said couldn't understand opposition Japanese believed many respects equal whites. Reaffirmed promise fastest Pacific service.
Ca. Hamilton.

This was repeated from 11 a.m. to 11.45 a.m., before Clifden finally O.K.'d it.

Messages Nos. 25 and 26, containing 50 words, to Lusaient and Heybourne and Croft, took from 11.58 to 12.34. Message No. 31 containing 52 words to *Express*, London, took from 4.40 to 5.26. All the above messages were on October 18th.

On the 17th inst., a message to the *Times*, London, from a gentleman who stated that he had crossed over with Marconi on the *St. Paul* in 1901, was sent six times at 1.20, 1.56, 1.60, 3.11, 3.32, and 3.39.

Another 14-word message inquiring about the weather, signed Regan, of the Associated Press, to McCollins, 24, Old Jury, London, was sent six times between 5.58 p.m. and 6.47 p.m.

(3.) The statement that 20 words per minute, or 1,200 per hour, were sent.

The actual rate was three words per minute, or counting repetitions as original messages, seven words per minute.

The actual rate of operation may be seen by the following records of work on October 14th, when messages began to be exchanged (an exceptionally unfavourable example), and October 29th (an exceptionally favourable example).

October 14th.

2.26 p.m. Glace Bay says :—

No. 13, Gb. to Cdn.
Hall, care Expanse, London.
To avoid possible risk through suddenly subjecting machinery to continuous running, think desirable conduct first few weeks day service only of say twelve hours telegraph through *Clifden*. Number of words as arranged remain good.
Sig. Marconi.

This was sent twice at a rate of seven words per minute between 2.26 and 3.08.

3.08. Glace Bay repeats message again twice.

3.45. Glace Bay repeats above message once more.

4.15. Glace Bay repeats above message once more.

4.56. Glace Bay repeated the message from commencement down to the words "through suddenly subjecting,"

three times, and Clifden O.K.'d it and asked for some information.

October 29th.

3.55 p.m.—Clifden says :—

(Calls Gb. several times, Rd. Rd. O.K. Rd. heres Dh.) Sd. Hnr.——West Strand.

To Marconi.

To what number of words per *diam* are you prepared to increase Press service.

Hall.

To what number of words per *diam* are you prepared to increase Press service.

Hall (3.55.)

4 p.m.—Glace Bay says :—

O.K. Rd. Rd.

Sd. Hnr. 9 Gb. Hall, Expanse, London.

Five hundred words per day each way must not be greatly exceeded until my return. Marconi (4.02.)

Nil. Nil.

4.02 p.m.—Clifden says :—

(Makes few V's. Calls Gb.) "U. send it be breatly. U send it be breatly isn't it greatly. Greatly Rd. Rd. Rd. Hang on tis. 3. Con." (4.07.)

4.12 p.m.—Glace Bay says :—

3. 3. 3. Cdn. 7 Greatly 7 Greatly O.K. heres. Dh.

Sd. Hnr. 1dh.Nr.Ten.Gb. 47.

To Bramadyne,

Grand Hotel, Harrogate.

Thanks for telegram sorry meeting not yet fixed do not understand how Press silent on wireless as we have been sending daily messages from start to *Mail*, *Morning Leader*, *Telegraph*, *Chronicle*, *Standard*, *Matin*, and others also the other way for American papers.

Marconi.

3/ N. N. N. N. G. (4.20 p.m.)

4.24 p.m.—Clifden says :—

(Makes few V's Calls Gb.) O.K. Rd. Rd. Rd. Nothing here yet. Nothing here yet.

G.G.G.G. Cdn. (4.25 p.m.)

4.30 p.m.—Glace Bay says :—

Sd. Hnr. Nr. Eleven. To. Entwistle. Cdn. Inform Solari he must apply to me for particulars. Marconi. Nr. AA. Gb. Entwistle. Cdn. Inform Solari he must apply to me for particulars. Marconi.

N.N. 3 (4.35 p.m.)

4.37 p.m.—Clifden says :—

Gb. Gb. Gb. OK. Rd. Rd. Rd. Nothing here. Gone it is. Cd. (4.38 p.m.)

4.42 p.m.—Glace Bay says :—

O.K. Sd. Hnr. 12. Gb.

To. Entwistle. Cdn.

Have noticed here on several occasions *varves* suddenly going wrong and losing sensitiveness through apparently becoming too conductive for oscillations this often cause of weak signals find reducing voltage sometimes restores sensitiveness. Please ask Woodward keep sharp lookout. Marconi.

(4.48 p.m.)

4.53 p.m.—Clifden says :—

(Calls Gb.) OK. Rd. Rd. Becoming G.G.G. Cdn. (4.54 p.m.)

4.57 p.m.—Glace Bay says :—

? ? ? Becoming too conductive? Becoming too. O.K. Non Non *sang on wat.* 3.

(4.59 p.m.)

5.05 p.m.—Clifden says :—

O.K. Rd. Rd. Rd. Tnks. Tnks. (5.04 p.m.)

5.15 p.m.—Neither sending.

The messages given above both from Glace Bay, Nova Scotia, and Clifden, Ireland, were received by two operators at Brant Rock, Massachusetts. Some were also received by the Company's New York operator, and some were received at the Brant Rock station on the automatic recorder used at that station when operating at rates of 250 words per minute and upwards. The messages were taken down exactly as received, including spelling.

Clifden was spelt with two f's the first few days, and later changed to one f. Where two f's were sent the word is underscored to show that it was probably a mistake. Similarly "*varves*" should probably be "valves."

No method of secret sending was used either at Glace Bay or Clifden. Although there are more than a dozen wireless stations in the neighbourhood of Brant Rock, owing to the superior arrangements for cutting out interference and atmospheric disturbances, the messages from Clifden were, it will be seen from the above, apparently received better at Brant Rock than at Glace Bay. Glace Bay and Clifden have not exactly the same wave length, and the shape of the wave would not be considered up to date, being much broader than is advisable for cutting out interference and atmospheric disturbances. The wave used at Clifden is slightly the better.

It will be seen from the above that the statements made by some technical papers, to the effect that commercial wireless telegraphy has been inaugurated, across the Atlantic are premature. This of itself would, perhaps, not be of so much importance but for the injurious effect which such premature statements have on the real development of the art. After the publication by the National Electric Signaling Co. (*Electrician*, July 26th, 1907, and ELECTRICAL REVIEW, September 6th, 1907) of the fact that daylight absorption could be overcome by the use of frequencies lower than 90,000, and that communication had been maintained by the National Electric Signaling Co. across the Atlantic from north to south—*i.e.*, from Massachusetts to the West Indies (a distance of 1,700 miles, or within a few per cent. of that from Newfoundland to Ireland), for three months during daylight, and at the rate of 25 words per minute, and the statement that this discovery meant that wireless telegraphy across the Atlantic from east to west was merely a question of licences, it was evident that one of the chief difficulties had been removed, and the fact that Signor Marconi has been able to transmit messages over this distance through using a frequency of 70,000 per second is an interesting confirmation of this discovery.

Aside entirely from the question whether the apparatus and methods at present in use at the Glace Bay and Clifden stations, from the long wave and local condenser circuit used for sending to the valves used for receiving, were not invented and patented by other inventors in the wireless field, it must, I think, be admitted that there is at the present time no operation which can properly be called commercial in the same sense in which we speak of the commercial working of cables. While the boldness of the Marconi Co. in making this claim may possibly be admired, it cannot fail to have an injurious effect upon the development of wireless telegraphy in general, and it must be remembered that working at the present time of the year is particularly easy, for the atmospheric disturbances which form one of the chief difficulties in wireless operations during the summer months have almost entirely disappeared by the end of September. The system as at present installed is not capable of commercial operation, and is very far behind the times in the following respects :—

1. Slow speed : Wireless messages were transmitted across the Atlantic nearly two years ago in the presence of independent experts at the rate of 25 words per minute at night time, and from Massachusetts to the West Indies at the same rate in daylight, in the spring and summer of the present year. Even assuming that the speed of the Glace Bay and Clifden stations can be raised from the present seven words per minute up to 20, a speed of 250 words per minute per wireless circuit has been reached at other trans-Atlantic stations. Using 12 circuits per tower, which has been done, though not all simultaneously on account of lack of apparatus, this would be equivalent to more than 30 trans-Atlantic cables working at a rate of 80 words per minute.

2. Lack of secrecy : While it is true that anyone familiar with Morse can read telegraph messages by going into a telegraph station, or can read messages passing over a wire from a loop in an adjoining field, and that secrecy has not been found in practice to be a very important feature in regular telegraph work, and while the most important messages would be sent in code, it is nevertheless preferable that wireless stations should use a system of secret sending such as the "scissor" method or some similar device which would at least not force the messages upon the attention of other stations.

Of course, if messages are sent at a high speed, say, 250 or 400 words per minute, this of itself renders it very difficult to tap messages, and in practical working may be sufficient, but at least one of these methods should be used.

3. Liability to interference : While it is true that wire telegraphy and telephone lines may be interfered with maliciously, and while undoubtedly malicious interference

with wireless systems would be dealt with by the Courts in the same way as wire lines, it is, nevertheless, advisable that wireless stations should not be liable to unintentional interference, and preferably that they should be protected against malicious interference.

There are a number of ways in which this can be done, as was shown, for example, by the U.S. Navy official tests some years ago at New York, where it was found impossible to produce interference with a station 226 yards away from the receiving station, and some such method should be used.

4. Atmospheric disturbances: Means should be provided for protecting wireless stations from atmospheric disturbances to at least the same extent as cables are. A cable can operate up to within a half-hour of the arrival of a lightning storm, and some of the well-known means for achieving this protection should be used for wireless stations. If it is not done, operation becomes impossible in the summer months, as with long-distance stations there is always some thunderstorm within the radius of operation.

5. Facilities for distributing messages: Wireless companies intending entering the field of commercial cable work, must be prepared to deliver their own messages. This means that the system must be capable of operating economically and reliably overland. Fortunately, the matter of land operation in connection with cable work is not so important as has been claimed, for the reason that investigation has shown that 70 per cent. of all cable messages in the United States come from 10 large cities. Any wireless company, therefore, which did not have a system capable of working overland (though in parenthesis it should be said that such systems are in existence) would have no difficulty in putting down trunk lines and getting sufficient inter-city business to pay for the maintenance, and leave the cable distributing business clear profit, since in inter-city business the capital invested in lines per message per year is much smaller than that in the case of feeders. The question of making arrangements with telephone companies for distributing messages is one which might be taken up if desired, though the inter-city messages and the cable messages will probably always constitute the cream of the business.

In what has been said above it should be clearly understood that there is no intention of reflecting upon the officers of the Marconi Co. Unfortunately, these officers have doubtless been unable to control as fully as they would have liked to have done the various exaggerated statements which have appeared in the Press. The writer has gone to considerable personal inconvenience in avoiding interfering in any way with the experiments at Glace Bay and Clifden. For example, when on October 15th the following message was received at 2.48 p.m.—

No. 14, Ms. GB.:
To Hall care Expanse, London.
I propose commencing service for transmission and reception Thursday Clifden working hours eleven a.m. to eleven p.m. G.M. telegraph if all right.
Marconi.

—instructions were at once given to the operators at the Brant Rock station not to do any experimental sending work during the balance of that week, and to use the non-interfering system or wireless telephone for all communication with New York.

5. The historical statements are, in many cases, not correct. It is not a fact that D's [S's?] were received in Newfoundland between 3 and 6 p.m. in December, 1901, from Poldhu, using a single untuned wire 400 ft. high. The fact that a coherer can be made to give a series of clicks of any desired number when connected to an antenna and there is a wind blowing has been known to wireless experimenters for some time. Doubtless Sig. Marconi at the time considered that he was receiving S's, but from the above examples of the difficulty in reading messages using 250 H.P., and with enormous capacities and receivers more sensitive even than the magnetic receiver, with tuned circuits, as at present used at Glace Bay and Clifden, anyone can form an opinion for himself whether messages were received with 10 KW. energy, a single untuned wire 400 ft. high and a carbon coherer. It is also not correct that the Anglo-American Cable Co. prevented the continuance of these experiments. I have no acquaintance or relations with the officers of the Anglo-American Cable Co., and no relations and but slight acquaintance with the officers of any other cable company, but shortly after this statement was made, the Anglo-American Co. published the correspondence on the matter, from which it would appear that they had merely entered a formal protest against the infringement of their monopoly as regards commercial working, and according to correspondence as published, they specifically went on to state that they had no objection to Sig. Marconi carrying on any scientific experiments that he wished. As this correspondence was published and has never been controverted, it may, I think, be taken as correct.

With reference to the transmission of the message from the President to King Edward in January, 1903, the fact that this message, after its receipt at the Holland House, was transmitted by cable, has been common knowledge for some time. Four different explanations have been given at different times as to why no return message was sent, in view of the statement that Poldhu was in communication with Wellfleet and acknowledged receiving the message, but the following cablegram will show that Sig. Marconi cannot be held in any way responsible for such statement :—

No. CB 20	Cable Message.	A—A. No. 31.
Check 23	W.U. Telegraph Co.	Sent 6.36 p.
Wellfleet, Mass.	1 —— 19 —— 1903.	
	1 —— 34 p.m.	

Wellfleet, Mass.
Expanse, Ldn.
President's message to King despatched successfully from Cape Cod to Poldu direct, and also *via* Capebreton you may publish text immediately.
Marconi.

It will be noted that the cablegram makes no mention whatever of any communication from Poldhu, and that Sig. Marconi cables the London office of the Marconi Co. the very necessary information that the message had been "despatched," so that the text could be published as having been received.

The question has several times been raised as to why wireless telegraphy has not come into commercial use, and it may be well to give the answer here. The reason is that up to the present time it has been absolutely impossible for any wireless company outside of the Marconi Co. to obtain permits for commercial operation. The following brief statement of some of the attempts which have been made by one company to obtain permits will explain the situation in the clearest way :—

1. Application made for working in Great Britain: Granted through the kindness of the Postmaster-General a few months ago; too late, however, to permit of the erection of stations this year.

2. Newfoundland: Rejected on account of exclusive licence given Marconi for 10 years.

3. Sable Island: Applied for in 1902. Later allowed to Marconi.

4. Bermuda: Applied for at various times since 1902, backed by petitions signed by principal merchants. Up to date refused.

5. Jamaica and other West Indian Islands: Refused.

6. Cuba: Granted on condition that company should purchase land and erect station, and that after this had been done the tolls for messages and taxes would be determined by Cuban Government.

7. France: No reply.

8. Spain: No reply.

9. Australia and New Zealand: Refused.

10. Brazil: Stations constructed and operated successfully experimentally, but permit for commercial working refused.

The above brief statement of the results of some of the applications made for permits to operate commercially will explain sufficiently and completely the reason wireless telegraphy is not at the present time in commercial operation.

As to the reason why it has been impossible to obtain these permits, I consider that this is due primarily, if not entirely, to the publication of exaggerated and untrue reports as to results obtained. Unfortunately, this has led to a general incredulity in regard to the possibilities of the whole art, and under the circumstances, however oppressive and detrimental to the progress of the art we may feel the restrictions to be which have been proposed by the various governments, we cannot rightly blame the responsible officials for their attitude. What we must hope for is a severe censorship on the part of the various technical

journals in regard to statements of results obtained, so that in time a knowledge of the real state of the art may be at the disposal of the various government officials concerned. If the present note, which has been written with great reluctance, shall have any influence in bringing about this result, the writer will feel that it has not been written in vain.

Reginald A. Fessenden.

CORRESPONDENCE.

Letters received by us after **5 p.m. on Tuesday** *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Publicity Methods.

I was extremely interested in the commonsense facts stated in the columns of your current issue, under the title of "Et Cetera." The remarks therein made are eminently practical, and if adhered to would be productive of far more satisfactory results at less expense, than most of the ideas put forward in your earlier issues, or in other journals containing articles on the subject of publicity methods.

It may interest some to know our experiences here on the West Coast of Ireland, and I may state at once that people in Galway are just as keen to grasp new methods as are those in more populous cities, but they do so strictly on the merits of the article being brought to their notice, in the sense that one of the greatest advantages, of adopting the use of a particular article, is a monetary one. Until we began exploiting Osram and tantalum lamps, the number of old carbon lamps in persistent use was as good an example as one could wish for in "how not to light one's premises." Consumers either could not or would not understand that electric lamps will not last for ever, and we recently sent to each consumer a circular couched in simple style, with facts stated in pounds, shillings and pence, and candle-powers, strictly eliminating such terms as watts per candle, amperes, or efficiencies; because we might just as well have printed the whole thing in Chinese as to have included them. It was not sufficient to send out circulars. A practical illustration was necessary, and we commenced in the windows and shop of a large drapers. The advertisement was a good one, and coupled with figures given in the circular, produced the result required. It is satisfactory to state that we are now supplying the new lamps, Osram and tantalum (new, be it understood, to this part of the country) as quickly as we can get them in. Through no cause of our making, a further advantage these lamps have over the ordinary carbon lamps was amply illustrated one evening during the past week. Owing to a "feeder" being burned out, the pressure in the immediate vicinity was temporarily reduced some few volts, and in consequence, those consumers who were burning carbon lamps suffered with bad light; on the other hand, those who had Osram and tantalum lamps in use, scarcely noticed any difference at all in the power of the light from such, and certainly from what I saw of the various lamps at the time, the difference in light-giving properties between the carbon and metal filament lamps was woefully to the disadvantage of the former.

While on this subject it might be argued by some that the introduction of more efficient lamps tends to, and probably would, reduce the income derived from the sale of electricity. Any far-seeing engineer, however, would overrule such opinions, because, first, the fact of being able to supply twice the light to a consumer for the same cost as before when using carbon lamps, enables the supply company more decisively to compete against the incandescent gas mantle, and, with some tactful persuasion, to induce people using such, to substitute for it the new forms of electric lamps. Secondly, it may be the case that in a certain district where there are many old inefficient lamps in use, the main cables supplying this particular district may be so loaded that it becomes unsafe to take on more consumers; whereas by a general introduction of more efficient lamps, it thereby becomes possible to connect on quite a number of new consumers, while still keeping within the carrying capacity of the distributor. The extra income so desired should easily counterbalance the small drop in income from each of the old consumers, and the company have the further satisfaction of knowing that the latter are generally pleased at obtaining more light at less cost.

In regard to a demand for electrical apparatus for home and office use, callers at our offices have shown great interest in a radiator which we now have in use, and also in an electric fan used during the summer. So far as I can ascertain, such apparatus has never been seen here, before much less used; and from inquiries made, I am quite certain that when we commence pushing these things, there will be a demand for them, especially for the reason that gas costs 5s. per 1,000 cb. ft., and at this price we can easily compete with gas heaters.

Reverting to the article "Et Cetera," the advice given as to the enclosing of circulars and appointment forms with the quarterly accounts, is worthy of trial, even if it only gives a consumer an opportunity of making an appointment solely to grumble at the amount of his account—such, at any rate, is an opportunity of seeing a person who otherwise may be difficult of access. An interview by appointment is far more satisf actory to both parties than a "call in as you pass the house" method.

If enclosures are easily understood, briefly and strictly to the point, a consumer or possible consumer, to whom such are sent, if specifically interested, will either call at the company offices, should this be convenient, or else make an appointment. To the casual caller the consumer is, nine times out of ten, "not in."

P. A. Spalding,
Engineer and Manager, The Galway Electric Co., Ltd.
Galway, *November 4th*, 1907.

The Suggestion Box.

The other day I happened to be looking through an old copy of the American *Electrical World*, and came across an article on "The Suggestion Box." It struck me at the time what a useful thing it would be in engineering works were it to be adopted and worked properly. I am aware that there are some companies in this country who have adopted it, but only a few, and even these are for the workmen only, and not for any members of the staff, such as draughtsmen, &c. I know of a member on a certain engineering company's staff who, when in the workshop talking over a job with one of the workmen, was told by the workman of a certain way of doing the job in particular, which would cause a considerable saving in manufacture. The member of the staff, who was a draughtsman, asked him why he did not put the suggestion in "The Suggestion Box," and was told that if he did he would in all probability get the "sack." His reason for saying this was that the foreman would be more or less jealous of him and get rid of him before he was promoted into the foreman's place.

Why is the "Suggestion Box" put in the works for the workmen only and not for the engineering staff also? Can any manager or chief engineer of an engineering company answer this for me?

I think that the general feeling amongst assistant engineers and draughtsmen is as follows:—Take a draughtsman for instance. He serves an apprenticeship with an engineering company, and when this is completed, he goes to two or three other companies for, say, two years each, and gets what he considers a fairly good experience on whatever work he has specialised in, then he gets a post with, say, the "fifth" company. Of course, he considers that with having been with four other companies, and knowing the details of their design and manufacture, he is, so to speak, a qualified man; quite right, too, provided that the man has worked hard and been interested in his work.

The first job he does for the "new company" may be quite new to them, but the draughtsman might have had some considerable experience on some other job identically the same, if he has, of course, he makes a "suggestion" to the "chief draughtsman" or the "chief designer," perhaps for better design from either an engineering or commercial standpoint or both. His suggestion may possibly be considered "favourably," but I am afraid in a great number of cases it will be otherwise. The draughtman goes on these lines for

say, 12 or 18 months, then gradually cools down and comes to the conclusion that the best thing is to keep quiet, do just as he is told, and no more. The result of this treatment is very disheartening to the draughtsman, and very detrimental to the welfare of the company. Having been employed by some of the leading engineering companies in this country, and after careful observation, I have come to the conclusion that the "chief draughtsman," as a rule, will not allow an "ordinary draughtsman" to make a suggestion, and in case he does manage to get a word in "edgeways," he might as well have saved his breath. Whilst the chief draughtsman holds the reins, he, as a rule, holds them tight, and takes great care not to let the management know that there is an "ordinary draughtsman" in the office who can save the company a fair amount of money each year. Of course, I don't say that all chief draughtsmen are like this, as in some companies the chief draughtsman does not always have the entire charge of the designing.

Suppose that an "ordinary draughtsman" does happen to make a suggestion in the presence of the chief draughtsman or the chief designer—what reply does he get? Very often, "poor," "no good," "wouldn't do," &c.; at the same time, the chief inwardly thinks it otherwise. Who brings it before the managment as "my latest idea" a few days or weeks later? The man who thought it out is lost in obscurity before the management.

Were there to be a suggestion box for the engineering assistants, draughtsmen, &c., and were suggestions (if any) to be considered by the management or a committee, I feel sure that it would be a good thing for the company and a good thing for those who make the suggestions, provided that they suggested something worthy of consideration, and that the management saw that they benefited by it either by paying them for it, or, better still, by promotion.

The above remarks are not intended only for those who are designing machinery, &c., but also for the managements of concerns, &c.

I trust that some of the readers of the ELECTRICAL REVIEW will let us have their opinion on this subject.

Suggestion Box.

Brakes for Tramway Cars.

It seems almost ungracious to say anything but "thank you" for the review of my book in your current issue. But the importance of the subject impels me to point out that it is just as necessary to keep the stopping power of the service brake unimpaired on down gradients as anywhere else, and that this cannot be done if it is employed for coasting, because its stopping power is diminished by just the amount of the gravity acceleration, which it is then called upon to neutralise. *Per contra*, a coasting brake is used to run on, not to stop with, and the use of the one should be just as much a matter of routine and habit as the other. It is a case of providing distinct appliances for distinct functions.

Henry M. Sayers.

London, *November 17th*, 1907.

Does Good Work Always Pay?

In your issue of the 25th ult. you published in your "Notes" columns a paragraph headed "How to Get Work," and therein made the implied suggestion that good work always pays, while inviting comments from your readers.

Though very reluctant, even when protected by the cloak of anonymity, to take up the *rôle* of the boastful "Pharisee," I have thought it necessary to challenge your suggestion, in case posterity (!) might be misled.

About 10 years ago, an energetic youth having forged his way through apprenticeships and technical education, and having "his honours thick upon him," was misguided enough to take up business as an electrical contractor. Fortified by the resolve to do only work of one quality, and that the best, with a moderate capital, but without the gentle breeze of influence, he launched out on the sea of commercialism. His good work and his acknowledged technical skill, combined with up-to-dateness in methods, gained him a not inconsiderable connection, and for about three years he made a little money, which all went to swell his capital.

Then came on an era of greatly increased competition; the jerry contractor arose—and sometimes (too seldom, alas!) also fell—in scores, and this young man, with perhaps a few more wrinkles on his forehead, pursued the even tenour of his way, refusing to "jerry" his work, and meeting competition not by reducing the quality of his work but by reducing the margin of his profit.

He saw others (even firms of some standing) supply surreptitiously material vastly inferior and cheaper than what was specified, and never once followed their example; he saw others obtain contracts at or under cost price, and then juggle up the price by unconscionable extras; he saw—but why continue the list—he saw all the dodges and refused to use any of them.

The work he carried out lasted five to eight or more years without costing a penny in repairs, and hence the very quality of his work shut out an important source of revenue.

And now, Sirs, that young man is without a business; without a situation; without several hundreds of pounds sterling, and with only a clear conscience to keep him warm because, and only because he was, to use the words of a prominent electrical engineer who knows him well, "too good an engineer to be ever successful as a contractor."

Does good work always pay in electrical contracting? Well, Mr. Editor, can you offer a fellow a job to deliver ELECTRICAL REVIEWS (he'll do it scientifically and expeditiously), for he is "sick unto death" of contracting.

Jay.

[Our sympathies are all with our unfortunate friend, with whose technical ability we have long been acquainted. We still believe, however, that good work will pay in the long run, and we are certain that our correspondent will never have cause to regret his square dealing.—EDS. E.R.]

Prepayment Meters.

The experience of "H.N." seems to have been singularly unfortunate, for most manufacturers of electrical apparatus would be only too glad to get a really satisfactory prepayment meter. I think it more than likely that "H.N.'s" device, though it may have been admirable as regards the coin actuating device, did not solve any better than existing devices the real troubles with this class of mechanism. Nearly all prepayment meters on the market are actuated by motor meters. Motor meters under the best possible conditions, that is to say, in a damp and dust-proof case with the minimum of fractional resistance in their train, can hardly be said to be entirely satisfactory instruments. When, however, they are expected to run in a case which cannot be made dust-proof or damp-proof, and to act not only as measuring instruments, but as motors delivering power, it is not at all surprising that they generally give a good deal of trouble. Another difficulty is that it is impossible to obtain for a prepayment meter a sufficient price to pay for the best possible design and workmanship.

If "H.N." has got over the difficulties I have named let him bring his device to Brighton, where we shall certainly look into it thoroughly.

H. Stafford Hatfield.

Brighton, *November 15th*, 1907.

Localising Faults.

My attention has just been called to Mr. W. A. Toppin's article "The Modern Three-wire Continuous-current System," which appeared in your issue of October 25th.

The method described of localising a fault is, I believe, not exactly new. The test is, I think, only applicable to cables that are not lead-covered or armoured. For with cables protected with a continuous metallic sheath, the greater portion of the leakage current will probably be carried by the sheath, and the greatest P.D. will be found at the point where the sheath makes the best contact with earth, which may, and probably will be, several yards from the fault.

With mains laid direct in the ground, I have generally found that the best contact between the metallic covering and earth was at joint and service boxes.

With lead-covered mains drawn into earthenware conduits, I think the inaccuracy is greater still. I am sure that the above subject must interest other engineers, and their views and experiences would be greatly appreciated by

A Fault Finder.

Telephones for the Deaf.

Can you, or any of your readers, oblige with the address of any firm who can supply the "head telephones," said to have been invented by the Chief of the Government Telephones of Sweden, for the use of the deaf?

O. J. B.

Bristol, *November 18th.*

[We believe that the device in question was no sooner issued than it was condemned as dangerous to the ear, which will not tolerate the presence of any foreign body whatever. Our correspondent may be interested in the device described on p. 679 of our issue of October 25th.—EDS. E.R.]

Monmouth Inquiry.

Please note that the recent L.G.B. inquiry held at Monmouth refers to work done at the commencement of the undertaking, some four or five years prior to the date of my appointment.

Arthur E. Wilkins,
Late Borough Electrical Engineer.

Dublin, *November 18th*, 1907.

PROCEEDINGS OF INSTITUTIONS.

The Dielectric Strength of Insulating Materials and the Grading of Cables.

By A. RUSSELL, M.A.

(*Paper read before the* INSTITUTION OF ELECTRICAL ENGINEERS, LONDON, *November 14th*, 1907.)

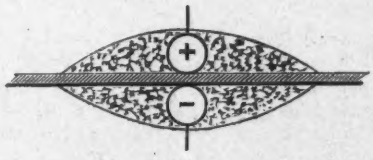
THE discussion on this paper (see abstract in our last issue) was opened by DR. FLEMING, who pointed out that the dielectric might be regarded not only as an insulating material, but also as a means of storing energy. In a condenser the amount of energy stored was proportional to the volume of the dielectric. Compressed air was a valuable dielectric, its resistance to rupture being proportional to the pressure, and being equal, at 14 atmospheres, to that of oil. A large factor of safety must be allowed in testing dielectrics; for instance, in testing a condenser with glass dielectric, the latter must not be tested above one-third of its ultimate breakdown pressure. Many dielectrics exhibited the phenomenon of ageing, and some kinds of glass in high-frequency condensers broke down after long use.

MR. G. H. NISBETT (B. I. & H. Cables) said that he disagreed with many of Mr. Russell's conclusions. He queried the reliability of the method suggested for finding the dielectric strength of an isotropic insulating material, doubting whether solids followed the same laws as liquids and gases. Referring to the partial breakdown of E.H.T. cables mentioned in the paper, he suggested that this was due to air-spaces in the waxy material used for impregnation, or to injury effected by bending the cable. A fluid dielectric was, in his opinion, necessary for high pressure cables, so that it might maintain close contact with the core. Mr. Nisbett also did not agree that the insulation could be injured by an excessive testing pressure, unless an immediate breakdown occurred. A cable that would break down with 20,000 volts in two hours might be stressed at that pressure for 1¾ hours without failing; if it were again tested with the same pressure after a short interval, it would break down in a quarter of an hour, but if it were allowed to rest for 24 hours before repeating the test, it would again be found capable of enduring the test for two hours. The insulation resistance also would fall during the application of the test pressure, but would be restored after 24 hours' rest. Hence there was no permanent injury due to the high-pressure test. The usual test pressure must be capable of breaking down a thickness of air at least as great as that of the dielectric; otherwise cracks and fissures might escape detection. The wide difference between the breakdown pressures found by Jona for equal thicknesses of paper insulation wound on wires of small and large diameters respectively was, in his opinion, due to mechanical reasons, such as damage to the paper in bending over a small radius. His own experiments would lead one to exactly opposite conclusions; cables of 7/16 and 37/16 gauge, identically insulated, broke down with 53,000 and 37,000 volts respectively. He did not approve of grading as a commercial possibility; Mr. Jona's cable was insulated with ¾ rubber and ¼ paper, the insulation alone costing £700 per mile, whereas the equivalent amount of paper insulation would cost only £130 per mile, and could stand the same tests. Moreover, the capacity and dielectric hysteresis would be high in the graded cable. The cable-makers resented the charge of rule-of-thumb design that was brought against them; they were not told the conditions of working, the resonance voltage to which the cables were subject, the wave-form, the temperature at which the cables would be worked, &c. For example, some 6,000-volt cable in London was found to be exposed frequently to a pressure of 18,000 volts, due to resonance, which it withstood safely. In view of the ignorance of both engineer and cable maker as to the working conditions, it was necessary to provide an ample margin of dielectric strength.

MR. W. H. PATCHELL congratulated the meeting on having at last seen a cable maker there, and pointed out that Mr. O'Gorman had patented the system of lead-sheathing the inner core and grading the insulating material, followed by Jona. He was informed at Niagara that the 20,000-volt cables there gave much trouble until grading was adopted, by which means the difficulty was completely overcome. Varnished cambric was used next the core, followed by paper.

MR. M. J. P. O'GORMAN said that the methods which he had advocated six years ago had been taken up in Italy and Germany, but not in this country. Mr. Russell had defined the electric stress in the dielectric, but was he justified in assuming that the actual strain in the latter was directly proportional to the stress—especially at such short distances as were met with in cables? He thought the linear law might be accepted, but it had not been proved. Mr. Whitehead had worked out with him an independent proof of Mr. Russell's conclusions, which might in time influence the cable-makers. Commercial dielectrics were not homogeneous; in practice they varied more than 30 per cent., so that the saving of 33 per cent. mentioned in the paper could not be realised. This was the best reason for postponing the question of grading. The explanation of Mr. Nisbett's experiments on the recovery of cables was that materials of high capacity, such as water, tended to move to the places of highest stress, thus accumulating and in time breaking down the cable; but during a rest, they diffused away from those points. (MR. NISBETT: If Mr. O'Gorman will substitute "oil" for "water," he will be very near the truth.)

MR. A. CAMPBELL objected to the use of the term "dielectric coefficient," which was the same as "dielectric constant," and "specific inductive capacity." He preferred Heaviside's expression, "permittivity." Referring to the difficulty of testing sheets of insulating material on Mr. Russell's system, he suggested embedding the electrodes in some material of similar permittivity to that under test, as shown in the figure below.



MR. J. F. WATSON (Callender's) expressed his conviction that partially developed faults might often be found, in cables of all types and makes.

MR. C. C. PATERSON inquired whether electrodes with rounded edges, or very large spherical electrodes, would serve for testing sheets of insulating material.

MR. C. P. SPARKS (Vice-President) said that there were great practical difficulties in the way of grading cables. As a user of cables, he wanted them to last for 25 or 30 years, and to secure this he preferred to have only one kind of insulating material in them. Regarding the difference in breakdown pressure due to the use of small diameters of core, he described his experience with 17 miles of rubber-insulated cable having a cross-sectional area of 0·0075 sq. in., diameter 0·36 in., and insulation thickness 0·09 in., on which 32 faults had developed in 10 years; 22 miles of similar rubber cable of 0·15 sq. in., 0·5 in. diameter, 0·11 in. insulation, developed three faults in 11 years, and a third rubber cable of the same section, with 0·14 in. insulation, 14 miles long, bore 2,000 volts for four years and 6,000 volts for six years without any faults. He had used 200 miles of paper-insulated cable at 2,000 and 6,000 volts, which had so high a factor of safety that no faults were traceable to the cables themselves. He sympathised with the cable-makers, who, he was sure, spent much time and money in testing, with a view to improving their products. England was not behind-hand; she had always led the way, and was still unexcelled in cable making.

MR. J. T. MORRIS (communicated): Instead of grading the dielectric, another possible method of obtaining an approximately even distribution of the potential gradient in the insulation of a cable is one which was suggested by me some two years ago, at a course of lectures on E.H.T. cables. It can most easily be applied in the case of A.C. transmissions. To the best of my belief it is novel. The plan is to insert one or two wrappings of conducting layers (such as thin copper tape, or thin lead sheathing) so that the dielectric of the cable is divided into two or three equal parts. These conducting sheaths are then connected to suitable tapping points on the transformer supplying the cable, thus maintaining these sheaths at the desired intermediate potentials.

MR. RUSSELL'S reply will be communicated to the *Journal*.

Recent Developments in Single-phase Work.

On Thursday last week a paper on this subject was read by Mr. V. E. Walters before the Birmingham and District Electric Club.

The author showed that the single-phase motor was capable of starting against heavy loads with a moderate starting current, and that its speed could be varied over a wide range by simple methods. The repulsion type had the advantage of good starting performance, while the simple induction motor had better running qualities; combining these two, by arranging suitable means for changing from the repulsion to the inducrion type at full speed, a motor was obtained which was satisfactory in both starting and running. Such motors were capable of driving lifts, even on 100-cycle circuits, starting with twice full-load torque and twice full-load current, while they were easily reversible by means of a simple change-over switch.

The Rhodes motor was provided with two pairs of brushes, the direction of rotation depending upon which pair was short-circuited. The shaft was also fitted with an automatic centrifugal governor which short-circuited the brushes when full speed was attained.

Bakers' dough mixers provided a very exacting load, as the mixer started up light and ran for five minutes in the forward direction, with the load increasing to a maximum as the mixture thickened: the motor must then be reversed under full load and run backwards for 30 seconds to clear the blades, after which it would be started forward again for five minutes, and so on. This work, however, was efficiently performed by a repulsion-induction motor, controlled by a change-over chopper switch only. The same type of motor had been applied to organ blowing, a fan being driven by the motor at a distance of 50 yd. from the organ. The controller consisted of a D.P. switch at the keyboard of the organ. The simplicity of control rendered this type of motor particularly suitable for use in connection with automatically-controlled pumps and air compressors, maintaining constant water-level or air pressure.

By inserting a resistance in series with the rotor, and employing a drum controller, variable speeds could be obtained.

In order to improve the power factor, when the frequency was high, it was desirable to run the motor at as high a speed as was practicable; it was also found that with high frequency the motors ran better at high than at low voltage. With frequencies of 50 cycles or less, the motors were successful on all usual voltages. Pointing out the advantages of single-phase motors as compared with D.C. and polyphase motors for traction, the author again preferred the repulsion-induction type to its rivals, as high voltage could be applied to the stator without step-down transformers, while the power factor was high, and the motor possessed a powerful starting torque, with a wide range of speed. He then proceeded to describe the Winter-Eichberg motor, which he regarded as the most promising of all types for traction.

Institution of Electrical Engineers (Birmingham Local Section).

On Wednesday last Prof. G. Kapp delivered his inaugural address as chairman, taking up the question of technical education. This question had been debated in the Press, the committee room, and on the platform for many years, and yet no agreement had been reached. The reason was obvious; the conditions of the various technical trades were so different that no general formula would suit them all. Even in one particular branch (say engineering manufacture) there was great diversity of opinion. He would only discuss the best method for that particular district and university.

The inspection of the laboratories would show them how far they had been able to go in a practical way to meet the requirements of the industry for men, and how, on the other hand, the district had rendered them valuable assistance.

It was important that students should become acquainted with the latest type of plant supplied by leading manufacturers as it came on the market, for the student of the present time must in the natural order of things become either the designer, the user, or the buyer of plant at some future time. To meet this difficulty, Mr. Chamberlain had suggested that the manufacturers in the district should be asked to lend machines and other apparatus of their latest type from time to time. This suggestion had met with a generous response. In this manner the firms were working hand in hand with them, and were materially furthering the cause of technical education. He wished, however, to enlist their help in yet another direction, namely, in the training of the men in a still more direct way. He suggested that firms should allow students to work in the shop during vacation time, no premium being required nor pay given. There was nothing new in this suggestion; it was, in fact, well known under the term "sandwich system," and was in use in various institutions both in Scotland and in England.

The most formidable obstacle in the way of the more general introduction of the "sandwich system" was the "premium pupil system," brought down from the good old times when technical instruction could not be acquired in any other way.

Under modern conditions the premium pupil system must on the whole fail to produce really efficient engineers, and it was this failure of an old system which had led to the establishment of technical universities and colleges.

On the question of workshop courses opinions were divided. Such courses alone were not sufficient to supply the practical side of technical education. In addition to the general idea of the handicraft which the student could get by attending the workshop courses at the university, he required some experience in shop routine which the university could not give him.

By alternating scientific and practical tuition, each would be more effective than where they were separated by a long period. If a graduate had to work for two years in the shop after he had completely finished his studies, he was in danger of forgetting much of his science. If, on the other hand, the student could devote himself entirely during three or four months in the summer to shop work, and need not open a book during all this time, he would certainly do his shop work well, and he would come back to his studies mentally refreshed. Having seen something of practical work, he would be in a better position for profiting by scientific instruction.

The suggestion which he put before the leaders of the electrical industry in that district was that they should assist in the task of educating efficient engineers by giving facilities for work in the vacations; these facilities to be offered to students who had during the season's work shown that they would profit by them and were, in fact, worthy of the privilege. As a general rule, each student would, year after year, go back to the same firm, and thus go through various departments. There might, perhaps, be a finishing term of six months after the fourth year, when the man would get a nominal salary, but these were details which would have to be arranged according to the particular circumstances in each case. The advantage of the sandwich system to the student was obvious; but it also had advantages for the firm. First and foremost, the advantage which the industry as a whole must derive from the better practical training of the rising generation; then the advantage to each particular firm. The firm would have an opportunity of watching the men and seeing how they shaped. If they should at any future time require to replenish their staff, they would not have to take a stranger by advertisement, but they would have the pick of the best men out of a group they had themselves helped to train.

Finally, there was the advantage to the university itself. In all such establishments there was a natural tendency to lay more stress on the purely scientific as distinguished from the purely practical side of the work, so that in course of time, if no corrective influence from outside were applied, the latter must suffer. In the sandwich system they had such a corrective influence; the students themselves would supply it.

There were other places in the kingdom where the system was at work. In America it was fairly general, and it had also been introduced in our colonies—notably in New Zealand—with beneficial results.

The Faraday Society.

The Faraday Society opened the autumn session on Tuesday, October 29th, when some interesting new developments of aluminothermic or "thermitic" (to coin a new word) reductions formed the principal topic of discussion.

Before the meeting, Mr. N. T. Wilsmore, M.Sc., who was in the chair, was able to make the gratifying announcement that Sir Oliver Lodge had accepted the invitation of the Council to succeed the late Sir William Perkin as President of the Society. The presidential address will probably be delivered early in the New Year.

The first of the two "thermitic" papers down for reading was by Mr. F. E. Weston and H. R. Ellis, and dealt with the reduction by aluminium powder of boric anhydride and silica, as there appeared to be some doubt as to the conditions—if at all—under which these reductions took place. The authors' experiments, some of which were repeated, accompanied by brilliant pyrotechnics, on a small crucible scale at the meeting, established the fact that a most important determining feature of these and similar reductions is the state of division of the ingredients used. Thus, mixtures in molecular proportions of the finest aluminium powder, and powdered boric anhydride (B_2O_3) that will pass through a 14,400 mesh, react at once in the cold on starting the usual magnesium and barium peroxide fuse. On the other hand, if coarser B_2O_3 is used (3,600 mesh), a temperature of 300° C. is necessary to sustain the action. Advantage has been taken of this fact by a German inventor to regulate the speed of the ordinary "thermit" reaction by gradating the size of the grains used. No less important a condition is the relative proportion of the ingredients present. If, instead of molecular proportions, the mixture $Al_2 + 2\ B_2O_3$ be used, the heat of a muffle furnace is necessary to start the reaction, no matter how finely powdered be the latter salt. A number of interesting experiments were made to determine the nature of the products resulting from these reactions, and to try and isolate the boron formed. Unfortunately, borides of aluminium, as well as boron, are produced, and these, together with the insoluble alumina slag, Al_2O_3, render it extremely difficult to isolate such boron as is formed in the free state. What Messrs. Weston and Ellis were particularly desirous of making was boron trichloride, and they enter fully in the paper into the chemistry of the formation of this secondary product, as well as into the somewhat delicate analytical problems involved in determining the exact products of the reactions.

The reduction of silica by means of aluminium, follows similar lines to the reduction of boron anhydride. The finer the variety of silica used, the more rapid and energetic was the reaction, precipitated silica being more easily reduced than kieselguhr, and this more easily than silver sand. With the former two again, the action took place in the cold (on applying the usual fuse), when the mixture had the composition $3\ Si\ O_2 + 8\ Al$, but when only half this quantity of aluminium was present ($3\ Si\ O_2 + 4\ Al$), a dull red heat was necessary. It was suggested that the excess of aluminium (or boron) in the richer mixture burnt in the air, combining both with oxygen and nitrogen, and that this separate reaction supplies much of the necessary heat, and thus causes the reduction to start at lower temperatures than when excess of the

oxides is present. It is possible that this is the case at the start of the action, but it is doubtful whether any burning of the metal takes place in a thermit reaction once the action has started, because the air may be excluded without noticeable effect.

The paper and experiments of Dr. F. M. Perkin and Mr. L. Platt dealt with the substitution of calcium hydride and of calcium, now a commercial product, for aluminium in the "thermit" reaction. Among the oxides successfully treated on mere ignition, and reduced to metallic form, were copper oxide, pyrolusite, haematite, and tin stone; in other cases, zinc, lead and antimony, the reduction was not satisfactory. Borax and boric oxide and silica require the heat of a muffle to start the reaction.

In view of the tungsten lamp, the reduction of wolframite by means of metallic calcium is of special interest and possible importance. The actions proceed spontaneously and vigorously, and as the slag of calcium oxide formed is, therefore, melted—a prime condition for the successful application of the "thermit" process for preparing metals—the tungsten is obtained in hard reguline form. Another very interesting reduction is that of strontium chloride by means of calcium, which, curiously, does not replace strontium from solution *in the cold*. $SrCl_2 + 2\,Ca$ is the best mixture to use. Although the authors have not yet succeeded in getting the strontium in a pure form, this method of reduction is well worthy of note, considering the difficulties in the way of preparing that metal by the electrolysis of the fused chloride. It is, indeed, questioned by some whether strontium ever has been really isolated in any quantities. It is noteworthy that, although strontium is electro-positive to calcium in solution at ordinary temperatures, it is yet replaced by the latter at high temperatures.

The by-products of many of these "thermit" reductions are likely to become of considerable industrial interest. Already many of these slags are being used for making crucibles that are in a high degree acid-resisting and fire-resisting.

Electrolysis in Liquefied Gases.—A preliminary communication on an important series of researches now being carried out by Dr. Bertram Steele, of Melbourne University, on the electrolysis of salts in liquefied gases, dealt with the case of potassium iodide dissolved in sulphur dioxide. From the fact that on some metallic cathodes potassium sulphite with an admixture of sulphur was deposited, Dr. Steele infers the existence of free sulphurcations in these solutions, a somewhat startling suggestion not, in the opinion of several speakers, warranted by the facts, which secondary chemical reactions would equally well explain. Unnecessary hypothesis is one of the familiar rocks on which the extreme ionic theory is often apt to split.

The Production of High Frequency Oscillations.

Mr. William Duddell, F.R.S., the new president of the Roentgen Society, delivered his address from the chair before that body on November 7th. His subject was "High Frequency Oscillations and the Various Methods of Producing Them." He dealt in turn with the spark-gap method and with the arc method with a direct-current supply. In the latter the high frequency oscillations were produced from an arc burning between solid carbons, the condenser overcharging itself and under-charging itself successively. The currents obtained by this method had a frequency of 20,000 or 30,000, which was not sufficient for most high frequency apparatus, but if the arc were put in a vapour of hydrogen or coal gas, the oscillations would take place with very much higher frequency, even when a large current was passed through the arc. The fundamental difference between the oscillations obtained by the two methods was that in the spark method there were groups of oscillations with periods of rest between them, and in the arc method the oscillations went on practically continuously. Mr. Duddell confessed himself ignorant as to the medical effect of these continuous oscillations. The burning they produced on the skin might be serious, and on the other hand, they might be of advantage for local heating purposes. The arc method was not suitable for obtaining very high frequency oscillations—*i.e.*, frequencies of more than a million. The practical range of frequencies with the spark method was very wide indeed. Mr. Duddell also referred to the method of producing high frequency by means of the rotating aluminium disk. The disk when rotated acquired on its surface a film of oxide, and high-frequency oscillations were set up in the circuit. He found this method to be not at all continuous but very intermittent, and he had not been able to obtain very large powers out of it. Speaking of unstable conductors, in which an increase of current was accompanied by a decrease of potential difference, Mr. Duddell mentioned the Nernst lamp filament, and said that he had been quite unable to obtain any high-frequency oscillatory current out of it at all, but he saw by the German Press that some Continental workers claimed to have done so. In conclusion, Mr. Duddell appealed to medical men to say what voltages and currents they really required. Hitherto the physicist and the medical man had been working in the dark, because neither knew what the other wanted.

Prof. Silvanus Thompson, in proposing a vote of thanks, endorsed the appeal to the medical fraternity.

Dr. Deane Butcher said that the better plan would be for the physicists to endeavour to produce as many varieties of electrical frequency as possible, and then the medical men themselves would choose out those which were more or less suitable for their special purposes.

Physical Society.

At the meeting held on November 8th, 1907, Dr. C. Chree, F.R.S., vice-president, in the chair, Dr. Fleming, in opening the discussion on Mr. Campbell's paper "On the Use of Variable Mutual nductances," asked the author how his method compared in accuracy with the Carey Foster method, using a commutator to add up the impulses. He had frequently measured mutual inductance by determining the self-inductances of the primary and secondary joined in series, with the windings first helping each other and then opposing each other. He asked if the author's methods were applicable when dealing with the high frequencies used in wireless telegraphy.

Mr. A. Russell agreed with the author in thinking that mutual inductance was sometimes easier to calculate and easier to measure than self-inductance. The variable mutual inductance standard shown was very compact, and would be a great acquisition to a physical laboratory. In calculating self-inductance, the variable current density over the cross-section of the wire sometimes brought in serious difficulties. The measurement of self-inductance in these cases might possibly be made by Mr. Campbell's method, but the limitations introduced into his formulæ by the assumption that the back E.M.F. was proportional to the rate at which the total current was changing would have to be considered.

Mr. Campbell, in reply to Dr. Fleming, said the methods of measuring mutual inductance described in the paper were more convenient and direct-reading than that of Carey Foster, although they were not so absolute. They were of higher accuracy than the difference-method, in which the primary and secondary were put in series and their combined self-inductance measured both with the windings helping and opposing. In reply to Dr. Fleming and Mr. Russell, the methods of measurement described were not intended, in general, for use with high frequencies of the order of those used in wave telegraphy, where resonance methods appear to be the only ones available. Mr. Campbell mentioned that the correction for the small inductance of the rheostat in method (B) could be got rid of by making the rheostat of constant inductance, this being attained by running a manganin and a copper wire side by side with a travelling contact across them, the current entering by the copper at one end and leaving by the manganin at the other.

A paper "On a Freehand Graphic way of Determining Stream Surfaces and Equipotentials" was read by Mr. L. F. Richardson.

A paper by Dr. J. Morrow, "On the Lateral Vibration of Bars supported at Two Points with One End Overhanging," was read by the Secretary.

Comparative Performance of Steam and Electric Locomotives.

By Albert H. Armstrong.

(*Abstract of paper read before the* American Institute of Electrical Engineers, *New York, on November 8th*, 1907.)

Before considering the electric locomotive, much the simpler o the two, it is advisable to determine the general characteristics and limitations of the steam locomotive viewed from the standpoint of the electrical engineer, in order that the scope of the problem may be thoroughly understood and the lines of contrast be sharply drawn.

Without considering the reasons governing the introduction of the electric locomotives at termini and in tunnels, we find in a comparison of the characteristics of the steam and electric locomotives a contrast so marked that it shows not only the superiority of the electric locomotive for general railway conditions, but it also suggests changes of a fundamental nature in present methods of

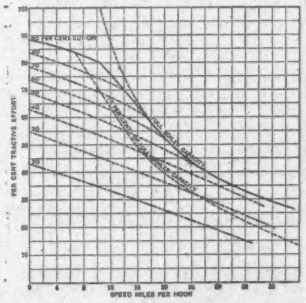


Fig. 1.—Typical Steam Locomotive Characteristic (Simple).

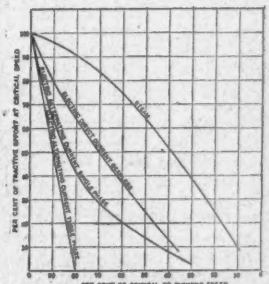


Fig. 2.—Typical Characteristics of Steam and Electric Locomotives.

operation now necessary with steam locomotives. And these benefits to be secured not only occur in the operation of passenger trains, but are felt to an even greater degree in the haulage of the heaviest freight trains, a field supposedly the exclusive domain of the steam locomotive.

In general, the electric locomotive must compete with the compound steam locomotive on level divisions and the simple engine on heavy grade divisions, although the Mallet compound has lately been introduced with some success in this latter class of work.

The general shape of the steam locomotive characteristic is given in fig. 1, which shows the relation between the speed and tractive effort of a simple consolidation locomotive designed for heavy freight service. Owing to clearances it is seldom that a locomotive can work at more than 90 per cent. of the theoretical full stroke, and hence the maximum tractive effort at starting with lever in the corner will not be much greater than 88 per cent. of the theoretical tractive effort available with gauge pressure in the cylinders. An inspection of fig. 1 shows that the steam locomotive is limited as to maximum tractive effort by its engine design, and

limited as to the speed at which this tractive effort is available by the capacity of the boiler to supply steam. Thus, assuming that the locomotive will give 88 per cent. of its theoretical tractive effort when starting, it is capable of providing but 80 per cent. tractive effort at a speed of 10·6 miles per hour (with the constants of the particular locomotive chosen for illustration) at which the boiler is giving its full output. Hence higher speeds can only be reached with a lesser cut-off and a consequent reduction in mean effective pressure and tractive effort. Locomotive engines are generally designed to give their maximum tractive effort at 90 per cent. theoretical cut-off at a point corresponding to a coefficient of adhesion of approximately 22 per cent. of the weight upon the drivers; that is, at about slipping point of steam locomotives with good rail conditions. It is immediately evident, therefore, that the tonnage rating of the locomotive on ruling grade must be so proportioned that the maximum tractive effort called for will be less than the available tractive effort of the locomotive in order to provide a small percentage, say, 10 or 15 per cent., for possible starting under maximum grade and load conditions. In other words, as the steam locomotive is designed so that the maximum tractive effort is delivered at a point not greater than 22 per cent. of the weight upon the drivers, it is not possible to take advantage of possible abnormally good rail conditions (either natural or made abnormal by the use of sand) as the engine itself will fail to deliver any excess tractive effort thus made available with increased coefficient of adhesion.

On the other hand, the tractive effort of the electric locomotive is limited only by the adhesion between driving wheels and rail, and aside from some 15 per cent. greater adhesion possible with the uniform tractive effort provided by the electric locomotive, it is possible with this type of motive power to take momentary advantage of abnormally good rail conditions or to derive full benefit from the use of sand; indeed, tests have been taken with electric locomotives showing as high as 35 per cent. coefficient

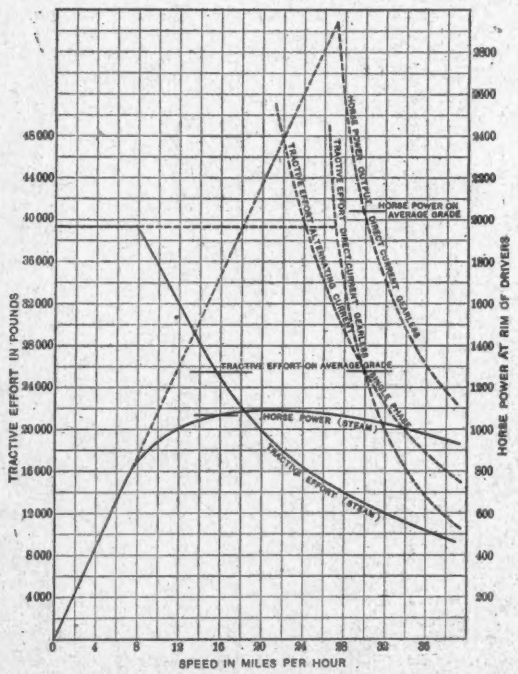

TRACTIVE EFFORT IN POUNDS
HORSE POWER AT RIM OF DRIVERS
SPEED IN MILES PER HOUR
HORSE POWER OUTPUT
TRACTIVE EFFORT DIRECT CURRENT GEARLESS
TRACTIVE EFFORT ALTERNATING CURRENT GEARLESS
HORSE POWER ON AVERAGE GRADE
TRACTIVE EFFORT ON AVERAGE GRADE
HORSE POWER (STEAM)
TRACTIVE EFFORT (STEAM)
SINGLE PHASE
DIRECT CURRENT GEARLESS

Fig. 3.—Steam and Electric Locomotive Characteristics.

of adhesion between driving wheels and rails. This point is emphasised as with the greater tractive effort of the electric locomotive it becomes possible to give it a higher tonnage rating for the same weight upon the drivers than would be possible with steam locomotives operating over the same track profile.

Fig. 2 has been prepared contrasting the characteristics of the steam locomotive and the direct-current gearless, alternating-current single-phase geared, and alternating-current three-phase geared electric locomotives. As all types of motive power share in common the fact of a certain critical speed beyond which full tractive effort cannot be maintained, the curves have been prepared on the basis of showing the relation between percentage of maximum tractive effort available at speeds higher than the critical speed, ordinates being tractive effort and abscissas percentage of critical speed to running speed.

A more familiar presentation is given in fig. 3, showing a concrete case of a 22 by 30 steam locomotive of the simple type equipped with 57-in. drivers, contrasted with both an alternating-current geared and a direct-current gearless electric locomotive designed for the same tractive effort both maximum and running, but for a higher speed. The contrast of these different speed characteristics brings out sharply the small speed variation with different tractive efforts delivered by the electric locomotives, this small variation being even more marked in the case of the direct-current gearless than in the case of the alternating-current geared motor working at a lower iron saturation and thus affording a more sloping speed characteristic.

The steam locomotive chosen is typical of those in general use upon our mountain-grade divisions, the tonnage rating in operation of this particular locomotive being such as to call for a tractive effort of 25,600 lb. on *average* grade and 33,200 lb. on the maximum ruling grade occurring on a certain engine division, thus leaving a margin of 6,300 lb. above the demands of maximum tonnage on maximum ruling grade for starting the train from rest.

The maximum speed available at the different tractive efforts is a matter of boiler capacity, condition of boiler, quality of coal, and efficiency of fireman. The first of these factors, the boiler capacity, can be controlled by properly proportioning the design of the boiler to engine capacity, but there are three other factors which the locomotive manufacturer cannot control, and two of these factors constitute sufficient cause to warrant a considerable reduction in the *theoretical rated capacity* of the boiler. Thus, referring to fig. 1, such a locomotive in prime condition carefully fired with the best coal (approximating 14,000 B.T.H.U.) should be able to deliver full tractive effort at 10·6 miles per hour, but in practice it has been found that the average condition of boilers and the average firing provided by the none too conscientious or diligent fireman, cuts the *sustained* boiler output down to not much greater than 75 per cent. of its output under what must be considered exceptional or momentary conditions.

The "critical speed" of the locomotive is 7·93 miles per hour when working at 75 per cent. of full attainable boiler capacity, and the coal consumed under such circumstances will be 4,360 lb. per hour, corresponding to 1·28 lb. of coal burned per square foot of heating surface, at which rate we would expect an evaporation of approximately 7 lb. of water per pound of coal.

What might be termed the "performance capacity" of a steam locomotive may be worked out from the speed and tractive effort characteristics given in fig. 3, using as a basis the 1,000 ton-miles trailing load moved per hour on a level or any gradient selected. The prevalence of 2·2 per cent. ruling grade on many of our western roads perhaps justifies the selection of that figure for demonstration purposes; and the coal consumed, crew wages, and maintenance charges may all be worked out from the basis of continuous operation per 1,000 ton-miles trailing load on 2·2 per cent. grade, these results being shown in fig. 4.

Having broadly outlined the performance characteristics of the simple consolidation engine frequently met with in heavy grade operation, it becomes necessary so to proportion the constants of

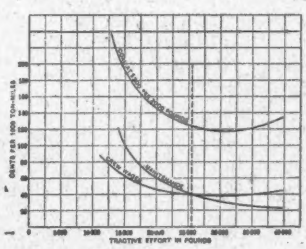


Fig. 4.—Performance Capacity of Steam Locomotive (Simple) Grade 2·2 per cent. (up).

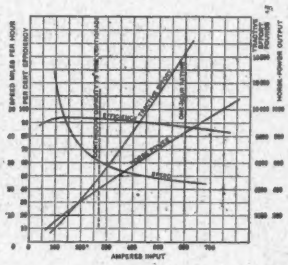


Fig. 5.—Direct-current Gearless Motor Characteristics, 1,200 volts.

the electric locomotive, assumed to replace it, as to gain the greatest benefit from the different inherent characteristics of the latter type of motive power.

Referring to fig. 2, it is evident that, with the small speed variation of the electric locomotive, and due to the fact that its motive power is separate from its unlimited source of power generation, it is possible to consider radical changes in the method of moving freight, more especially on mountain-grade divisions. It has become a partly accepted fact that the electric locomotive characteristic should be so proportioned as to enable it to operate trains at a high rate of speed on level track and at a much slower speed on grades, in fact, conforming with present steam practice in this respect. The writer would again point out that steam railroading to-day is in reality steam locomotive practice in that the speed possibilities of different track divisions are restricted to a large extent by the limitations of the steam locomotive. In other words, the only reason why it is common practice to run at very low speeds on mountain-grade divisions instead of continuing the high speeds in vogue on more level portions is because a steam locomotive cannot be built powerful enough to supply the heavy tractive effort required at any higher speeds than those now in vogue.

Except for the fact that curves are usually of shorter radius on heavy grades than on levels, there is no reason for the slower speed of trains, provided a type of motive power is available that is capable of supplying great draw-bar pulls at high speeds. It is just this characteristic which the electric locomotive possesses to an almost unlimited extent, and such locomotives can be built which are even more powerful and operate at higher speed than can be utilised at present.

The electric locomotive may be equipped with motors of several different types, each having characteristics best qualifying it for certain classes of work. As the direct current gearless motor can be built in the largest sizes, is the best understood, and is in successful operation upon a very important division of one of the largest steam roads, it is here chosen as the equipment of a typical electric locomotive.

The large output, 460 H.P. for one hour and 400 H.P. con-

tinuously, shown in fig. 5, illustrates what can be accomplished with this type of motor. The output of the complete locomotive is dependent upon the number of motors permitted with the construction adopted. Thus, such a four-motor equipment is capable of delivering a tractive effort of 56,800 lb. at a speed of 23 miles per hour approximately (depending upon the voltage) while the efficiency of conversion at this output would be 87 per cent., rising to a maximum of 93 per cent. at higher speeds and lower tractive effort. Another form of construction, say one similar to that employed in the largest Mallet compound, would permit the use of two four-axle articulated trucks, providing an equipment of eight motors and an output of 113,600 lb. at a speed of 23 miles per hour.

The same motors could readily be rewound to give the same tractive effort at *considerably increased speeds* if desired, without materially increasing the internal losses of conversion. Bearing fully in mind the fact that a single operator has this enormous energy under perfect control, and that such a locomotive could do the work of two or more Mallet compounds and several locomotives of the simple Consolidation type, it becomes evident that in the electric locomotive there are tremendous possibilities of improving present methods of railway operation as now conducted with the steam locomotive. Carrying the thought a step further and appreciating that several such electric locomotive units may be operated in a group forming a combined unit, it becomes evident that in the electric locomotive we have a type of motive power capable of furnishing any output in tractive effort and speed that present or future operating conditions may demand.

(To be concluded.)

LEGAL.

An Electric Shock Claim.

A compensation case arising out of an electric shock, in which the respondents were the Littleton Colliery Co., Chatsworth, was heard at Walsall County Court on Wednesday last week, when Mr. H. H. Jackson, solicitor, made an application on behalf of Wm. George Edwards, whose son, W. H. Edwards, was employed as a motor boy on September 11th, and was killed by an electric shock. It had been agreed between the parties that £25 be paid as compensation, and that amount had been duly paid into Court. Mr. Jackson's application was that an order should be made by the judge that the money be paid out of Court to the boy's father. His Honour said he must be satisfied that there were no other dependents. Mr. Jackson pointed out that the youth was 16 years of age, and had lived at home, so that under these circumstances there could be no other dependents. The father went into the witness-box, and stated that the boy had lived at home and handed his earnings to his mother, and that he (applicant) was quite willing to accept £25 in settlement. His Honour accordingly made an order that the money paid into Court should be handed over to the father.

Lift Accident Claim.

In the City of London Court on Monday, a greaser named Woodward sued his employers, the Underground Railways Co. of London, Ltd., under the Employers' Liability Act, for £200 damages for injuries sustained six months ago while employed at the Euston Station of the Charing Cross and Hampstead Railway. He was at work on a lift gate when, it is alleged, owing to a defective limit switch, the lift went too high and plaintiff was caught between the lift and a girder, and was so injured that he had since been unable to work. According to a report in the *Times*, evidence was given on behalf of the Otis Elevator Co. to show that plaintiff stood in a dangerous place, and that they had supplied 194 similar lifts for this and other tube railways in London. Plaintiff was awarded £50 damages.

Bellamy *v.* Wakefield and District Light Railway Co.

In the Chancery Division of the High Courts of Justice on Friday, November 15th, before Mr. Justice Joyce, this case was mentioned, Mr. Younger, K.C., stating that, although a definite agreement had not yet been come to, he hoped the action would be settled in another fortnight. The question, he said, was one as to the amount of damages.

Brockie-Pell Arc Lamp, Ltd.

Mr. Justice Parker on Tuesday heard the petition of Messrs. Gent & Co., Ltd., for a compulsory order for the winding-up of the Brockie-Pell Arc Lamp, Ltd., or in the alternative for a supervision order.

Mr. Clayton, for the petitioners, said the petition had stood over several times pending negotiations, and now they had arrived at terms, if his Lordship would sanction them. The petition was after a voluntary winding-up, and the chief ground of prejudice alleged was that shortly before the winding-up debentures for £6,000 were issued by the company to two of their directors to secure a liability which they had incurred on behalf of the company by a guarantee to the bank, and these directors had been appointed receivers and also voluntary liquidators in the winding-up. Their names were Henry Warner and Duncan Watson. It had now been arranged, subject to the approval of the Court and with the consent of these two directors, that a supervision order should be made, that Henry M'Clellen, who represented unsecured creditors, should be appointed an additional liquidator, and that Messrs. Warner and Watson should release the debentures so issued to them—they held other debentures which were not attached—without prejudice to their claim to rank as unsecured creditors, and that the costs of the petition should be paid out of the assets.

His Lordship observed that it was an exceptional case, but the settlement seemed reasonable, and he made the order accordingly.

Harman *v.* Shoreditch Borough Council.

On Wednesday, November 13th, before Mr. Justice Darling and a special jury, an action was brought by Thomas Samuel Harman against the Shoreditch Borough Council to recover damages for the loss that plaintiff alleged he had sustained on August 18th last by a fire, stated to be caused by an electric motor. Defendants denied breach of contract and negligence.

Mr. Eldon Bankes, K.C., for the plaintiff, said the action was brought to recover damages for loss sustained by the plaintiff by fire. He thought probably the real question was whether the jury were satisfied that the fire occurred as the result of negligence on the part of the Shoreditch Corporation in supplying an electric motor for the purpose of working a chaff-cutter on plaintiff's premises. For some three years prior to the date of this fire, chaff-cutting had been done by means of an electric motor. In 1905 the Shoreditch Corporation were suppliers of electricity within their district, and being desirous of supplying at a higher voltage, they applied to the London County Council for permission to do so. Permission was granted, and the voltage was altered accordingly. Defendants applied to the plaintiff asking for leave to take away their existing motor and supply them with a temporary one. The motor was taken away on August 14th, and plaintiff's case was that the temporary motor was absolutely unfit for the purpose for which it was used, and was a source of danger so long as it was working. It appeared that the motor had been used for the same purpose on the premises of a Mr. Fairweather. While it was there Mr. Fairweather was constantly complaining. The motor was always getting so hot that it was obviously a source of danger, and had to be stopped until it cooled. Although the Corporation officials knew this, somehow or other it came to be supplied to the plaintiff. An iron pulley was substituted for a wooden one, but it was always getting hot, and according to plaintiff's evidence, there was no doubt that the fire broke out in the end of the premises in which the motor was placed; their case was that the motor caused the fire, and if the electric motor caused the fire it would not be disputed that the defendants would be liable for a considerable amount. The action was brought partly in the interests of Mr. Harman and partly in the interests of an insurance company. The case for the plaintiff was that the motor was absolutely unfit for the purpose for which it was placed in the premises, because it would not work without getting overheated, and because it was not the proper sort of electric motor to place in premises like the plaintiff's.

Mr. Henry Francis Joel, an electrical engineer, said that, in his opinion, the motor was built to run at 100 volts, and it was run at 150 volts. It was a low-voltage motor.

In reply to his Lordship, Witness said that if a proper motor were put in, it would not be necessary to keep a pail of water near it. Witness added that the fact of the belt catching on the beam would cause the motor to vibrate.

Mr. John Robert Fairweather gave evidence as to the motor having been placed on his premises. It worked unsatisfactorily. It sparked very much and was over-heated, and they always had to stop it so that it might cool down. They worked the motor at 150 volts. He complained to the Council about the switch handle, and the Council told him to tie it over.

For the defence it was stated that the electric motor did not cause the fire; it was also suggested that the fire was caused by people smoking.

In reply to his Lordship, one witness said he might have set fire to the place by smoking a cigarette. Another witness said it was absolutely impossible that the electric motor could have caused the fire. It was also impossible that the motor could have taken fire without a smell.

The hearing was continued on the following day, when Mr. Joel, electrical engineer, was called to state that he was the maker of the electric motor. He added that if the current exceeded the safe limit, the switch would fly back.

This concluded the evidence, and his Lordship, in summing up, said that unless the jury were satisfied that the motor caused the fire, they would have to find a verdict for the defendants.

The jury found for the plaintiff, and his Lordship gave judgment in accordance with the findings for £2,250.

Condensing Plant.—Messrs. J. P. Hall & Sons, Ltd., of Peterborough, have recently received several orders for condensing plant, including one set for Twickenham Electricity Works, one set for Dartmouth Electricity Works, and one set for Finchley Urban District Council; they have also just recently supplied four large sets for delivery abroad.

BUSINESS NOTES.

Trade Statistics of Australia for 1906.—The following statement, showing the imports of electrical and other materials into Australia during 1906, is taken from the recently issued trade statistics. The figures for 1905 are added for purposes of comparison:—

	1905.	1906.
Electrical Materials.—	£	£
From United Kingdom	138,002	179,123
„ Germany	40,275	54,156
„ United States	22,118	19,219
„ Italy	1,734	1,622
„ Other countries	3,597	4,399
Total	205,726	258,519
Lamps and Lampware.—		
From United Kingdom	32,424	36,266
„ Germany	23,397	31,215
„ Sweden	5,352	6,059
„ United States	22,282	25,058
„ Other countries	1,486	1,760
Total	84,941	100,358
Gas and Oil Engines.—		
From United Kingdom	53,535	98,983
„ France	951	2,712
„ Germany	578	2,231
„ United States	17,997	24,079
„ Other countries	307	1,950
Total	73,368	129,955
High-speed and Turbine Engines: water and steam.—		
From United Kingdom	9,810	656
„ Germany	—	600
„ United States	97	—
Total	9,907	1,256
Other Engines, except Portable and Traction Engines and Fire Engines.—		
From United Kingdom	65,651	52,659
„ Germany	1,924	5,561
„ United States	82,674	7,877
„ Other countries	496	477
Total	150,745	66,574
Electrical Machinery and Apparatus.—		
From United Kingdom	117,897	117,852
„ Belgium	1,668	2,654
„ Germany	11,640	21,981
„ Sweden	12,521	12,966
„ Switzerland	6,178	1,182
„ United States	61,329	52,426
„ Other countries	2,119	3,009
Total	213,352	212,070
Mining Machinery.—		
From United Kingdom	44,505	31,817
„ Germany	10,074	19,536
„ United States	16,739	13,423
„ New Zealand	5,882	10,305
„ Other countries	4	25
Total	77,204	75,106
Machinery not specified, except Printing and Sewing Machines (includes Boilers and Pumps).—		
From United Kingdom	335,549	395,192
„ Germany	37,066	65,160
„ United States	149,347	154,712
„ Other countries	8,430	13,237
Total	530,392	628,301
Machine Tools.—		
From United Kingdom	38,993	56,319
„ France	738	1,376
„ Germany	5,169	8,928
„ United States	39,575	58,353
„ Other countries	362	933
Total	84,837	125,909
Wire: Iron and Steel.—		
From United Kingdom	31,077	40,578
„ Germany	161,967	325,146
„ United States	131,615	149,699
„ Other countries	2,805	4,743
Total	327,464	520,166
Wire, other: except barbed wire.—		
From United Kingdom	27,304	25,558
„ Germany	13,855	10,206
„ United States	15,759	10,543
„ Other countries	471	885
Total	57,389	47,192
Rails, and parts therefor.—		
From United Kingdom	111,344	132,522
„ Belgium	19,354	95,939
„ Germany	21,164	36,575
„ United States	53,163	75,144
„ Other countries	1,066	255
Total	206,091	340,435

Trade with East India.—The review of the trade of India in 1906-7, which has just been issued as a Parliamentary paper does not contain much information of interest to the electrical engineering trade. It refers to the year ended with March 31st, 1907, and shows that the imports of machinery again increased during the 12 months, they forming 25·59 per cent. of the total value of imported metals and manufactures thereof. The expansion in the use of machinery is becoming more general in regard to all classes, as, in addition to Bengal and Bombay, other provinces have made progress in their purchases from abroad. The totals of the various classes of machinery imported into India in the past two years have been (in thousands of rupees) as follows:—

	1906-7.	1905-6.
Textile machinery	2,27,45	2,48,98
Steam engines and parts	1,31,13	1,00,33
Electrical	27,04	23,78
Mining	6,21	7,46
Other descriptions...	1,88,05	1,12,00

It will be observed that a considerable augmentation took place in steam engines and electrical machinery. The imports of iron and steel into India also experienced a large increase, the British share rising by over 18 per cent. in quantity, and 16 per cent. in value, as compared with 1905-6, whereas a large retrogression took place in the tonnage and value of the imports from both Germany and Belgium. On the export side of the account, it is stated that electrical developments have led to an intensified demand for Indian mica, the exports of which advanced by 59·75 per cent., as compared with the year 1905-6. The price of lac has risen continuously in recent years as a consequence of the activity in the electrical industry, and the greater demand for high-class varnishes. India is the main source of supply, and there appears to be some reason, the report submits, to believe that the high level of prices has induced reckless gathering prejudicial to succeeding crops. The value of the exports of caoutchouc, which increased by 163 per cent. in 1904-5, and by 40·6 per cent. in 1905-6, declined by 12·76 per cent. in the past financial year. As to the apportionment of the foreign trade of India, the review shows that the United Kingdom participated to the extent of 66·8 per cent. in the value of the aggregate imports in 1906-7, as contrasted with 66·7 per cent. in the preceding year. Germany ranked second with 5·3 per cent. and 4·2 per cent., and Belgium third with 4 per cent. and 4·3 per cent. in the same years respectively. The share of the United Kingdom in the total exports from India in 1906-7 amounted to 26·9 per cent. of the value, as compared with 25·3 per cent. in 1905-6, and 27·5 per cent. in 1904-5. Germany occupied the second position last year with 11 per cent., as against 8·9 per cent., and 9·2 per cent. in 1905-6 and 1904-5 respectively, whilst China was third with 10·9 per cent., as contrasted with 13·5 per cent., and 12·6 per cent. in the two preceding years respectively.

Consular Notes.—Reporting recently on the Coal Mining Industry of Belgium, the British Consul-General at Antwerp states that the haulage machinery in the Belgian mines is operated for the most part by steam power. Some of the mines of the country have adopted electricity as the sole motive power for extraction, pumping and ventilation, and what are regarded as successful and economical results have been obtained.

Government Orders Placed Abroad.—The present Government has made a noteworthy beginning in the placing of orders abroad, judging from the official return which has been issued in relation to the contracts entered into by various departments with foreign firms or with contractors or agents who procure the articles from other countries. The return refers to the financial year ended March 31st, 1907, and shows that the total expenditure amounted to £519,228. On looking back to the return for the preceding financial year, we find that the sum of £183,082 was expended on purchases from abroad, so that the increase in the past financial year reaches the formidable sum of £336,146. This comparison is not given in this particular return, and it appears to be sought to

disarm those who refer to the previous return by the statement that the figures for 1906-7 are not properly comparable with those of former returns. However that may be, it is satisfactory to find that the Post Office Department has actually expended less in 1906-7 than in 1905-6, the totals being £56,340 and £69,988 respectively. The greater portion (£49,487) of the former was for telephone apparatus; telegraphic apparatus absorbed £1,693, and ebonite goods £1,038, all other items being individually of the value of less than £1,000. In the case of the Admiralty the sum of £1,534 was expended on Delagon cells, £49 on carbon brushes, and £29 on Thomson meters. The War Office purchased telephones for £647, arc lamps and parts for £169, and a demagnetiser for £17; the Works (English) Department paid £468 for electric clock systems (parts), and the Irish Works Department spent £9 on the acquisition of French telephone clocks.

Foreign Enterprise in South Africa.—The Siemens-Schuckert Works Co. for the West Coast of South America is the title of a new company which has been constituted in Berlin with a capital of £25,000 to market the electrical manufactures of the Siemens-Schuckert Works Co. and the Siemens & Halske Co. in the part of America in question. The company also proposes to conclude and carry out transactions in the electrical engineering branch, and to participate in all kinds of electrical undertakings and incidental operations.

A Fulham Contract.—The Law and Parliamentary Committee of the Borough Council, in a report circulated on Monday, refer to a difficulty which has arisen with Messrs. Westwood & Wright who had a contract for a condensing pipe, sump and river work at the generating station. The amount of the contract was £4,314, and it took about a year to complete. After the work had been in hand for three months, the borough electrical engineer found that about £1,127 worth of the work could be dispensed with, and, in accordance with his powers, struck out this part of the contract. The extras on the contract amounted to about £300. The contractors claimed to be allowed 25 per cent. of the value of the work omitted, on the ground that provision was made for executing the whole contract. They asked to be paid a sum of £306 16s. to cover their trade charges and profit, which they said would have been included in their estimate on the sections carried out if they had known that serious deductions were likely to be made. The Committee have agreed to a settlement of the claim by payment of a sum of £105.

Catalogues and Lists.—From the P. & O. Steam Navigation Co. we have received a hanging wall-sheet, giving dates of outward and homeward mails for 1908; also a list of their fleet. The upper half of the design of the sheet shows a picture in appropriate colouring of a P. & O. liner under full steam.

The Electrical Co., Ltd., 121-125, Charing Cross Road, W.C.—Several new publications. One is an advance sheet from their forthcoming Fittings Catalogue, showing several lines of electric light fittings. The second is a leaflet relating to, and giving prices of, their "Aegma" metallic filament lamps, which are claimed to consume only 1 watt per c.p., and to have a life of about 800 to 1,000 c.p., with practically no depreciation in candle-power. They are equally suitable for a.c. and d.c., and can be burnt in any position. The sizes made are 25 and 50 c.p. for voltages between 100 and 130. Miniature lamps for accumulators are also supplied.

Messrs. Plutte, Scheele & Co., 18 and 19, Queenhithe, London, E.C.—32 pp. booklet, giving details of their "Vita" belt-driven and electric air propellers and steel cased fans. Illustrations (line and half-tone) appear, and tabulated particulars of sizes, prices, reference numbers and so on, are given.

Mr. Robt. W. Paul, Newton Avenue Works, New Southgate, N.—A number of further sections of his new catalogue, describing respectively his testing keys and switches, Cohen's barretter, scales and lanterns for reflecting instruments, Pointer galvanometers, rheostats, and slide-wire bridges.

Messrs. Siemens Bros. Dynamo Works, Ltd., York Mansion, Westminster, S.W.—Four illustrated leaflets (S.D., 1 to 4) describing their watt-hour meters and ampere-hour meters.

Messrs. Bagshawe & Co., Ltd., Dunstable Works, Dunstable.—Leaflets relating to their vertical elevators and conveyors, and giving a view of the company's works in the U.S.A.

The Small Power Dynamo and Motor Co., Old Lane, Openshaw, Manchester.—Two four-page circulars describing respectively their alternating to direct-current motor-generator sets, and their small d.c. dynamos and motors. Prices, weights, and code-words are tabulated.

The General Electric Co., Ltd., 71, Queen Victoria Street, E.C.—Large and effective showcard, with the words "Osram Lamps," and some other words of interest concerning them, standing out plainly in white lettering on a dark green background. The consumer entering the premises of a contractor or salesman, will be struck with the saving of 70 per cent. to be obtained in his current bill, and with the life of fully 1,000 hours without loss of candle-power. From the same company we have also received a copy of their Section "O" (eighth edition) catalogue of electro-medical apparatus. In this are illustrated and priced many types of portable induction coils, magneto machines, electrodes, electrolysis apparatus, Röntgen ray apparatus and tubes, cautery apparatus, dental engines, batteries, &c. A third G.E.C. publication received this week is a price list of their Sherardised Geekoduct, and fittings and accessories therefor.

The Electric and Ordnance Accessories Co., Ltd., Stellite Works, Cheston Road, Aston, Birmingham.—44-page catalogue, (with an effective cover and using glazed art paper throughout) in which their Victor arc lamps are finely illustrated. A full account of the special features of the lamps of the enclosed, miniature, and flame types is given. The "Victor" patent clutch, resistances, auto-cut-outs, and general accessories, are also particularised. The lamps are claimed to be specially free from complicated and delicate mechanism.

The Union Electric Co., Ltd., Park Street, Southwark, S.E.—Advance copy of price list No. 6,011 (Section). It contains 12 pages of illustrated, tabulated, and priced information relating to their low-tension switchgear, including main switches for medium and heavy currents for low-tension circuits, arranged both for placing in front and behind the switchboard panel. The "C" type switch, which is fitted with magnetic blow-out, as well as auxiliary sparking tips, enabling the switch to be opened under full load and full pressure without any damage to the working contacts, is described, and, as shown in the list, these switches are arranged for coupling together as single, double or triple pole.

"Osram" G.E.C. Lamps.—On Wednesday, 13th inst., for the occasion of the Conservative delegates' reception and banquet to Mr. A. J. Balfour, the Town Hall, Birmingham, was lighted throughout with Osram lamps. These were installed by Mr. O. C. Knight, electrical contractor, Edmund Street, Birmingham. The improvement in the lighting was very marked.

Marseilles Electrical Exhibition.—We are asked to state that intending exhibitors can have full information regarding this event on applying to M. Jauffret, 77, Fleet Street, E.C., where temporary offices of the Exhibition have been installed.

For Sale.—The plant, machinery and effects of the Scottish Cyanide Co., Ltd. (in liquidation), is to be offered for sale by public auction on December 18th and 19th at Leven, by Messrs. J. & R. Edmiston. The plant includes Willans & Robinson's engines, Lancashire boilers, Mather & Platt low-pressure alternators, 15 electric furnaces, two large Dowson gas producers, &c. Some particulars appear among our advertisements to-day.

Book Notices.—"Fractional Pitch Windings for Induction Motors." By C. A. Adams, W. K. Cabot and G. Æ. Irving, jun. Reprint of paper read before the American I.E.E. on June 28th, 1907.

"Indian and Eastern Engineer" Year Book, 1908. London: The Indian and Eastern Engineer Co., Ltd., 1907.

"La Technologia delle Saldature Autogene dei Metalli." By S. Ragno. Milan: Ulrico Hoepli. 1907.

"Fortschritte der Elektrotechnik." 1906. By Dr. K. Strecker. Parts 3 and 4. Berlin: Julius Springer. 1907.

"Souvenir of the Opening of the Municipal Technical Institute, Belfast." The Institute. Price 1s.

Dissolutions and Liquidations.—British Uralite Co., Ltd.—By instruction of the Court, meetings of the prior lien debenture-holders, debenture-holders, and unsecured creditors, were to be held yesterday, November 21st, at Cannon Street Hotel, for the purpose of ascertaining their wishes concerning the proposal of a scheme for the realisation of the assets already set forth in an issued circular.

Pioneer Gas, Electric Light and Power Co. of South Africa, Ltd.—This company is winding up voluntarily.

N. S. Electric Storage Co., Ltd.—A meeting is to be held at 139, Queen Victoria Street, E.C., on December 16th, to hear an account of the winding up from the liquidator (Mr. G. Pepper).

With reference to the notice which appeared in our issue of November 15th concerning the liquidation of the Electrical Publishing Co., Ltd. (the publishers of the *Electrical Magazine*), we are asked to mention that this company must not be confused with *The Electrician* Printing and Publishing Co., Ltd., of Salisbury Court. The latter company had no connection with the company now in liquidation.

The Aluminium Syndicate, Ltd.—Creditors must send particulars of their debts, &c., to Mr. D. C. Jolley, 1, London Wall Buildings, E.C., the liquidator, by December 19th.

St. Petersburg Exhibition.—Dr. Paul Dvorkovitz, 45, St. Mary Axe, E.C., the honorary English representative of the International Exhibition of Modern Lighting and Heating Appliances, to be held shortly at St. Petersburg, asks us to draw attention to the fact that there are now only a few weeks left in which English manufacturers of lighting or heating appliances can secure space for the Exhibition. Inasmuch as the Exhibition, which opens on January 28th next, is to be international in character, every effort has been put forth in order to induce foreign exhibitors to give their support. Dr. Dvorkovitz will be pleased to give our readers any information they may desire. The Exhibition will remain open for one month.

Bankruptcy Proceedings.—Andrew Matson, electrical engineer, Stockton-on-Tees.—November 30th is the last day for receipt of proofs for intended dividend by J. R. Stubbs, trustee, 8, Albert Road, Middlesbrough.

Wiring Systems.—Referring to our note in a recent issue under the above heading, Mr. A. G. Beaver, manager of the Sun Electrical Co., writes, saying that "there can be no doubt whatever, as you say, that the future lies with the 'piping system in which the joints are mechanically made in such a way as shall preserve electrical continuity,' and further, 'the whole of the

materials, whether cables or casing, must be able to be handled and erected by wiremen,' I would go further than this, and say that the only system which will prevail in this end, is one which is absolutely standardised and can be erected merely with the aid of a blow lamp and solder, and in which, by the addition of a few small accessories, all the various little difficulties which arise in connection with wiring work can be overcome without having to order special boxes or to put up make-shift arrangements specially devised for that particular job. All of these requirements, I claim, are met by the 'Kalkos' system of wiring and accessories which is now being placed on the market."

This system was described in our issue of September 27th.

Trade Announcements.—With reference to our article on the "Psychology of the Follow-up System" (see ELECTRICAL REVIEW, November 8th), the *Business Man's Magazine*, to which we referred as containing the original article on the subject, by W. A. Procter, is published at Thanet House, 231-232, Strand, London, W.C.

MESSRS. RHODES MOTORS, LTD., have appointed Mr. Brinley Rees, of Albert Chambers, High Street, Cardiff, as their district representative for South Wales.

MR. F. W. RHODES, of Ampere Works, Morley, whose works were totally destroyed by fire, has opened a new workshop and showroom at the corner of Ackroyd Street and Commercial Street, where he is installing an entirely new stock.

LIGHTING and POWER NOTES.

Aylesbury.—The B. of T. has refused to grant an extension of time for carrying out the E.L. order, which will now lapse.

Blackpool.—The borough electrical engineer, Mr. C. Furness, is circularising his consumers, explaining the advantages to be obtained by using the Nernst lamp. The Corporation employs a man specially for fitting the renewals to clients' lamps, at the price of burners only. The scheme has been worked out in conjunction with the Electrical Co., from whom full particulars can be obtained.

Brierfield (Lancs.).—At a meeting of the District Council last week-end, a report was presented prepared by the and the accountant, on electric lighting stations in towns of a similar size to Brierfield. On November 15th it was decided that a deputation should visit towns mentioned with a view to coming to some decision as to a scheme.

Canada.—The engineers of the Ontario Hydro-electric Power Commission have completed the surveys for the main transmission lines from Niagara Falls to the municipalities in the Western Power Union, and are now engaged in the survey of several of the branch lines. The main lines are from the Falls to Hamilton, from Hamilton to Toronto, from Hamilton to Brantford, Woodstock, Ingersoll and London, and from Hamilton to Guelph, Hespeller, Galt, Berlin, Stratford, St. Mary's and London. A loop system is contemplated in the event of all or most of the municipalities definitely deciding upon the adoption of the power scheme. As the lines would be duplicated, a breakdown in the service would be an impossibility. The total length of the loop line will be about 400 miles. The branch lines upon which surveys are now proceeding are from London to St. Thomas and from Galt to Brantford.

Clitheroe.—The T.C. has succeeded in securing a renewal of its Electric Lighting Order (1904) for a further period of 12 months.

Continental Notes.—GERMANY.—A project for the creation of a State monopoly in electricity is mooted by the Berlin correspondent of the *Magdeburger Zeitung*, who, as is well known, is in close touch with the Government.

SPAIN.—The electricity consumers in Madrid have banded themselves into a league to fight the trust which at present controls the private and public lighting of the city. The league, which has a membership of over 53,000, has taken a firm stand owing to the alleged high-handed action of the trust, but the officials of the latter refuse to give way, and have threatened to leave the city in darkness if their customers endeavour to enforce their demands. The Government has already intervened in the matter, and it is hoped that a satisfactory agreement may be arrived at.—*Globe.*

Coventry.—The sanction of the L.G.B. has been received to the borrowing of the following sums in respect of the electricity department: £1,300 for purchase of land adjoining canal; £24,125 for extension of works and plant; £2,225 for prospective expenditure on mains; £250 prospective expenditure on services; £400 prospective expenditure on meters; total, £28,300.

Dover.—The Admiralty has decided to erect a large electricity station for power and lighting for the Naval Harbour.

Dundee.—Last week the arc lamps which have recently been erected in the Overgate were turned on for the first time. The old gas lamps have been discarded, and arc lamps of the "Orifiamme" type introduced with effects which are regarded as highly satisfactory, and a decided improvement on the old lights. Looking to the success which has attended the above change, and to the great improvement effected in many ways, possibly the new Lighting Committee, which has been appointed, will see that a few more of the streets in the city are illuminated electrically. A sub-committee has been appointed, on the recommendation of Mr. Richardson, to negotiate for sites for two of the sub-stations included in the new scheme.

Haslingden.—The Corporation has agreed to consult Messrs. Handcock & Dykes on the question of the generation of electricity, after having previously decided to equip a station and electrical plant. This action has been taken in deference to public opinion, and the sanction for the actual erection will be deferred pending the expert's report being received.

Heston and Isleworth.—At Tuesday's meeting of the U.D.C, the Electric Lighting Committee presented a report on the outlay up to date on the works. This showed that £53,716 has been spent on the works and mains and land, of which only £51,015 was provided by loans. It was resolved to apply for an additional loan to defray the excess.

Horsforth.—The Electrical Distribution Co. is now laying mains, and it is expected that a supply of electricity will be started in the course of a fortnight. The Council is proposing to light the main streets electrically.

Hull.—A L.G.B. inquiry was held on November 13th, into the application of the T.C. for a loan of £46,527 for E.L. purposes—£31,000 for extensions for the next three years, and £15,527 for additional machinery, &c. There was no opposition.

India.—The *Calcutta Gazette* contains the announcement that the Lieutenant-Governor has granted a licence to Messrs. Hoare Miller & Co. for the supply of electrical energy to the public and for electric traction in portions of the Burdwan and Manbhum districts. The option of purchasing the undertaking is exerciseable at the end of 42 years, and thereafter at the end of each subsequent period of 10 years. This is the second industrial power electric licence granted recently in Bengal, the first being the Hooghly River licence from Hooghly to Budge Budge.

Llandudno.—The Pier Co. intends to promote a Bill in the next session of Parliament for a provisional order which will include power to lay down a line of tramways, and to supply electrical energy. An extensive power plant has recently been provided on the pier, and doubtless the following, among the objects cited, is intended to empower the company fully to exploit its generating plant:—"To empower the company to generate, sell, and deal in electrical energy, and to supply the same whether for purposes of light or power, to any other company, corporation, or person."

London.—The North Metropolitan Electric Power Supply Co. has recently adopted a novel method of introducing its business to the public. It may be necessary to first explain that a travelling show, better known as Poole's Myriorama, has been visiting the Town Hall, Edmonton. In view of this the company promptly arranged for a temporary supply to be given for the cinematograph and the lighting of the hall, in addition to which a large electric sign was erected, this being the first seen in the district. In consideration of the company's prompt action, arrangements were made for lantern slides to be exhibited dealing with the several uses of electricity, these being placed on the screen during the intervals between the pictures, and it would seem that the public present fully appreciated the unexpected advertisement thus served up.

WOOLWICH.—The Electrical Committee has recommended the Council to petition the B. of T. to reintroduce the Supply of Electricity Bill in the coming session of Parliament. The matter was brought up in connection with a decision of the West Ham Corporation, that it could not at present legally give a supply in bulk to North Woolwich.

BERMONDSEY.—The E.L. Committee has decided, with a view to ensuring the supply to consumers of reliable lamps, that in future the borough engineer shall keep a stock of lamps on hand, for those who require them.

MARYLEBONE.—The reorganisation of the staff of the electricity undertaking and the inter-relation of the several departments, and the books of reference kept by each has been for some time past under the consideration of the Electricity Supply Committee, who reported on Tuesday having effected several changes with a view to efficiency and economy. The Committee is of opinion that the engineer and manager should as far as possible be relieved of the office routine in order that he may be free to give full attention to the larger questions of efficiency of supply and growth of the business, and that the electrical accountant should have control of the office routine and clerical staff.

STOKE NEWINGTON.—The B.C. has under consideration the installation of an 80-KW. high speed generating set, switchgear, &c., in connection with its refuse destructor plant, with a view to supplying energy in conjunction with the public supply obtained through the Council's sub-station from the North Metropolitan Electrical Power Supply Co. The contract between the Council and company provides for such use of the destructor steam. Mr. Stevenson, of Talbot & Stevenson, has reported on the matter.

SOUTHWARK.—The recommendation of the E.L. Committee, in connection with extensions of the electrical works suggested by the borough electrical engineer, that no extension of the plant be made at the present time, has been defeated in Council.

Newport (Mon.).—With reference to the application of the T.C. for a loan of £10,000 for electricity purposes, the L.G.B. has intimated that consent cannot be given until an adverse

balance of £2,864 brought forward against the concern instead of being met out of the rates is removed, as losses should not be brought forward against prospective profits.

Oulton Broad.—By the agreement with the U.D.C., Lowestoft T.C. has decided to apply for a prov. order for E.L. at Oulton Broad. Energy will be supplied to the U.D.C. at the following prices:—Up to 30,000 units, 3d. per unit; over 30,000 units, 2¾d.; power, 2d. per unit up to 2,000 units, and 1¾d. per unit beyond.

Rochdale.—Among the matters to be included in the Corporation Bill in the next session of Parliament are powers to construct additional tramways, and to authorise the supply of electrical energy in certain districts outside the borough.

South Africa.—CAPE TOWN.—In connection with the coming gala season, an application has been received by the city electrical engineer from the Gala Committee for the electric lighting of the squares and the special illumination of the Government Avenue during the gala month. It is also intended to electrically illuminate the Green Point Athletic Grounds for the holding of the coloured people's carnival.

SEA POINT.—Strenuous efforts are being made to promote a company for the electric lighting of Sea Point and Green Point. The intention is to obtain a high-tension supply from Cape Town Corporation to a transformer station to be built at Three Anchor Bay—from that point the distribution would be undertaken by the company.

SIMONS TOWN.—At the last meeting of the Municipal Council a letter was read from the clerk to the Kalk Bay Council inquiring if the Simons Town Council would entertain the question of obtaining a bulk supply of electricity from his Council. The writer mentioned that the streets in the Kalk Bay district were now lit with 214 50-C.P. Osram lamps at a very moderate cost. It was decided to discuss the letter at a later date.

Springhead.—A year's extension of the E.L. order has been granted to the U.D.C. by the B. of T., which intimates that if no steps are taken by the expiration of that time to carry out the order, it will be revoked.

Swansea.—The R.D.C. has decided to apply for a prov. order for E.L. at Llansamlet. Energy will be obtained from the Neath R.D.C., which has acquired the undertaking in the Neath Rural area of the South Wales Power Co.

Thornhill.—The U.D.C. is applying to the B. of T. for a prov. order for E.L.

Willington.—The U.D.C. has decided by the casting vote of the chairman, to allow the use of overhead wires for the supply of electricity by the Durham County Electrical Power Distribution Co., which will supply energy at 3¾d. per unit, less 5 per cent.

Wirral.—The Caldy Manor Estate, Ltd., is applying to the B. of T. for a prov. order for E.L. at Caldy, in the district of the Wirral R.D.C.

Wood Norton (Worcestershire).—Messrs. Roger Dawson, Ltd., carried out a very large temporary electric light installation, including a complete generating plant, with steam engine, at the Duke of Orleans' estate at Wood Norton, Worcestershire, in connection with the wedding of Princess Louise of France and Prince Charles of Bourbon, which took place there on Saturday last. Over 300 men were employed night and day erecting a chapel, banqueting hall, kitchens, &c., and into these temporary buildings Messrs. Dawson put upwards of 500 lights. A part of the extensive grounds also was illuminated, eight projectors being used for this purpose, and for flooding the courtyard between the duke's house and the temporary buildings.

Yarmouth.—The T.C. has decided to have the entire borough lighted by electric glow lamps. The saving over gas is estimated at £185 11s. per annum.

TRAMWAY and RAILWAY NOTES.

Asia.—DAMASCUS.—In a recent report on the trade of the town, H.M. Consul reports that on February 7th of this year the company inaugurated the electric tramway, which is 5,300 m. long, connecting the two furthest extremities of the city. The rolling stock consists of 26 cars imported from Belgium. The minimum power at the waterfalls of Tekiyeh (some 90 ft. high) is calculated at 1,000 H.P.; three turbine-driven generators, also imported from Belgium, are installed; energy is conveyed overhead to Damascus—a distance of 19 miles.

Bacup.—The Corporation has decided to apply in the next session of Parliament for power to acquire that portion of the Rossendale Valley steam tramways undertaking within the borough, and to electrify the same. The proposed new tramways will be on a 4-ft. gauge, and will link up the most thickly populated area of Rossendale. The Bill will be deposited in the House of Commons by December 17th.

Barnes.—The Richmond Electric Light Co. has signified its intention to promote in the next session of Parliament a Bill authorising the construction of tramways in Richmond and Barnes It is understood that the company will ask for power for the construction of two tramways—one to start from the Fountain (Kew Road), *viâ* Lower Richmond Road, High Street, Mortlake, High Street, Barnes, to Castelnau and Hammersmith Bridge, and the other from Lower George Street, *via* Sheen Road and along the Upper Richmond Road, to Barnes Railway Tavern, from which it will run past Barnes Station, across the Common, and through Rock's Lane to Hammersmith Bridge. The District Council is also considering the feasibility of constructing and working tramways on its own account.

Belfast.—At the weekly meeting of the Tramways and Electrical Committee, the manager recommended the building of a number of top covers for the cars, the cost being estimated at £117 each—the covers will be made in the Corporation workshops. At the meeting a voluminous report from the expert of the Citizens' Association was submitted, in which it was alleged that a sum of £48,210 had been over-paid in connection with the reconstruction of the tramway system of the city. Mr. Cutler, the city surveyor, said that he was prepared to stand by his figures, and courted the fullest investigation. Mr. Cutler said he would prepare a report on the matter, and a motion thanking the Association for bringing the matter before the Committee was defeated. The items in which it is alleged that over-payment was made, include alleged errors in measurements of the line.

Continental Notes.—GERMANY.—The tour of investigation of electric railways in the United States and Mexico, to which reference was recently made in this journal, has now been concluded. Herr Wittfeld, of the Prussian Ministry of Railways and Public Works, returned from the journey on November 8th, his companions having been Herr Frischmuth, of the Siemens-Schuckert Works; Herr Pforr, of the Allgemeine Elektricitäts Gesellschaft; and Herr Jordan, of the Felten & Guilleaume-Lahmeyer Works, and other gentlemen. Some of the members of the Commission did not associate themselves with the Mexican part of the tour, and they, consequently, returned to Germany at an earlier date. The object of the investigation was to study the latest advances made in the working of main lines in the United States and in Mexico. In addition to the inspection of railways, the Commission paid a visit to the works of the Mexican Light and Power Co. at Necaxa. It is stated to be intended to utilise the information gained on the tour not only in connection with the conversion of the Berlin metropolitan railways, but also for several electric main lines, of which some prospect is said to be held out in Prussia. The conversion of the Berlin lines is, however, a matter of the remote future, as the work is promised in about ten years, whilst, at the same time, nothing is now heard of the construction of electric main lines starting outwards from Berlin.

A concession has been granted for the establishment of an electric motor-omnibus service between Baden and Alland. While the vehicles will run on the ordinary road, the motive-power will be furnished to them by means of overhead trolley wires, in the same way as on electric tramways. A special central power station is to be erected at Heilingenkreuz for the purpose, and also for supplying energy for the electric lighting of the last-named village.

BELGIUM.—After an interval of a year or two a new project has been brought forward for the establishment of an electric railway between Brussels and Antwerp, the author being M. Mullender, of Liége, who has applied to the Government for a concession. The railway would commence in Brussels at the Place de Brouckère, traverse the Boulevard de la Senne, and pass over the Senne to the gasworks. It would then proceed along the Willebroeck Canal to Vilvorde, thence in a straight line to Kiel-Porte de Boom and would enter Antwerp by following the route of various streets and terminate at the Grande Place in front of the Brabo statue. The total length of the proposed railway would be 26·66 miles, and the speed for 24 miles of this distance would be at the rate of 90 miles an hour.

SPAIN.—An application has been made by the Sociedad Anonima Nueva Montana for a concession for the construction of an electric tramway to join the existing one from Santander to Astillero with the town of Santander, in Pena Castillo. An application has also been made by Don Luis Ibanez Carreras for a concession for the construction of an electric tramway from Valencia to Pueblo Nuevo Del Mar and the Playas de la Malvarrosa, Caro and Arenas. —*Board of Trade Journal.*

Heston and Isleworth.—At Tuesday evening's meeting of the U.D.C., a motion was adopted unanimously in favour of a conference with the Southall-Norwood U.D.C. upon the most suitable means of establishing a cross-country line of electric trams or light railways, between Southall and Twickenham, by way of Hounslow.

Holywood, co. Down.—The company which proposes to build the line between Belfast and Holywood has again approached the Belfast Corporation with the view of making

an arrangement by which cars on the prospective line will be allowed to travel over the system of the former in order to obviate the necessity of a change of cars, but the Corporation has declined to give a definite reply for the present to the question. The Corporation has intimated that it is willing to supply sufficient energy to give a 10 minutes' services to Gelston's Corner in the suburbs of the city, and within a few yards of the company's system.

Kew.—The L.U.T. Co. announces its intention of introducing a Bill into Parliament giving power to run a line of tramways over Kew Bridge to link up with the existing horse tramway alongKew Road into Richmond. It also asks for time to carry out the electrification of the Kew Road line, for which it has statutory power.

Kirkcaldy.—A suggestion by the manager, Mr. Sellon, that the T.C. should run two of its cars over the Wemyss route on the same conditions that the Wemyss cars run over the Corporation route, has been agreed to, and a long-standing dispute has thus been settled.

London.—L.C.C.—The Highways Committee, in a report presented at Tuesday's meeting of the L.C.C., recalled the agreement of February 13th, 1905, under which the Council agreed to pay G. C. Milnes, Voss & Co., a sum of £4 10s., or such less sum as should be charged by the licensees to sub-licensees under the Magrini patent, for every electric car roof-cover made by, or on behalf of, the Council during a period of five years from the date of the licence. The Committee stated that the licensees applied for the payment of, and subsequently commenced an action to recover, royalties in respect of roof covers made by the Council itself, as well as 300 roof-covered cars recently supplied by Hurst, Nelson and Co., but as questions arose as to the validity of the patent, the Council contested the claim. Negotiations had been proceeding with the licensees, and as a result they were prepared to agree to the settlement of the action, and the termination of the license referred to, subject to certain conditions, including the payment by the Council of a sum of £2,250 and the taxed costs of the action. In the circumstances, the Committee thought that this proposal should be adopted, and it submitted recommendations in order to give effect to it.

The Highways Committee of the L.C.C. has recommended, and the Council has agreed, to abandon the proposed tramway to the Crystal Palace *via* West Norwood.

The newly electrified L.C.C. tramway between Highgate and Highbury has been completed. The completion of this section gives the L.C.C. a through route from Aldwych to Highgate, where a change of cars can be made on to the Metropolitan Electric Tramway Co.'s route to High Barnet in Hertfordshire.

The agitation in regard to the noise created by the London United Tramways in Ealing and Acton continues. An application has been made to the President of the Board of Trade for an interview on the subject, but was declined by that authority.

On November 30th the Strand Station of the G.N., Piccadilly and Brompton Railway is to be opened for traffic. This station will bring the whole of North and West London into direct communication with the East Strand district.

Paddington.—The solicitor to the Metropolitan Electric Tramways, Ltd., has informed the B.C. that his clients propose to apply next session for power to construct a tramway along the Harrow Road, in continuation of their existing lines from Amberley Road to Edgware Road.

Lambeth.—At a meeting of the Borough Council on November 14th, a letter was read from the B. of T. approving the proposed method of reconstructing for electric traction the tramways from Vauxhall Cross *viâ* South Lambeth Road, Stockwell Road and Gresham Road, to and across Brixton Road.

Morecambe.—On Monday the T.C. decided to promote a Bill in Parliament for the purchase of the horse traction system of the Morecambe Tramways Co. within the borough with a view to its ultimate electrification. The company has had powers since 1886.

Perth.—The Corporation, in its proposed provisional order, is asking for powers to extend the tramway depôt near the centre of the city.

South America.—Chile.—A company has been authorised to construct and exploit an electric railway from the fiscal depôts of the port of Valparaiso, through La Laguna to La Placilla or Penuelas.—*Board of Trade Journal.*

Buenos Ayres.—Mr. Augusto Limousin has been authorised by the Provincial Government to erect and exploit an electric power station in La Plata, under the same tariff conditions as established by existing laws Government will contract with Mr. Limousin for energy for 100 arc lamps for the lighting of La Plata. The new concern will enjoy the same privileges and exemptions as conceded to similar enterprises.—*Review of the River Plate.*

Torquay.—Major Pringle, of the B. of T., has inspected the new tramway route from the Strand to St. Marychurch Town Hall, *via* Welswood and Ilsham, and known as the Babbacombe Road route. This portion of the tramway will complete the four-mile circuit that has been sanctioned by the Corporation, and the service will be opened as soon as the sanction of the B. of T. is obtained. The next step to be taken by the company will be to obtain the consent of the Corporation to the laying of a tramway along the Torbay Road to Chelston.

TELEGRAPH and TELEPHONE NOTES.

Angola.—In a recent report on the trade of Angola, H.M. Consul states that that territory is connected with Europe and the Cape by the submarine cable of the West African and Eastern and South African Telegraph Companies, which communicate with the universal telegraph system. The head-quarters of the cable-laying ships on this coast is at Loanda, where cable tanks for 200 miles of cable have just been completed on the island side of the harbour. Several new overland lines were opened during 1906, and further extensions are in progress. The number of stations has been brought up to 63, with 1,949 miles of wire. A reduction has been made in the telegraph rates per word, messages to the United Kingdom costing 6·785 fr. instead of 10·93 fr. The extensions are being carried along the Benguella Railway line between Mossamedes and Cubango, and Novo Redondo and Lobito.

Australia.—The Government has decided to remove the Wakapuaka cable station to Nelson.

Brazil.—The *London Gazette* announces that the rates for telegrams to Brazil are as follows:—Brazil: Pernambuco, *vid* Madeira, Teneriffe or Dakar, 3s.; other places, except those on the Amazon, *vid* Madeira, Teneriffe or Dakar, 4s. (*vid* France-Teneriffe-Noronha and Brazilian landlines, 3s. 8d.). Places on the Amazon: first zone, *vid* Madeira, Noronha and Dakar routes, 5s. 2d. (*vid* Noronha and landlines, 4s. 11d.); second zone, by above routes, 6s. 5d. and 6s. 1d. respectively.

Egypt.—The telegraph system is now established between Wadelai and Nimule, on the Upper Nile.—*African Engineering.*

Johannesburg.—On October 26th the new telephone exchange was formally opened. The wires are now laid underground. The number of lines entering the building is 6,246. The message-rate system of charging is to be adopted, and instead of a charge of £20 yearly, in future a subscription of £7 10s. will entitle a renter to 600 calls. Over that number a charge of 2d. per call will be made up to 1,800; 1d. up to 2,400; and ½d. up to 4,800, with a maximum of £59 per annum.

Long-Distance Submarine Telephony.—The completion of the new submarine telephone cable between the German island of Fehmern, and the Danish island of Laaland, was recently mentioned in this journal. By means of this cable and other lines it is, or shortly will be, possible to communicate directly with Berlin without the inclusion of Hamburg in the circuit. It is now expected that the telephonic traffic between Germany and Sweden will be extended as a result of the establishment of the new German-Danish cable. At present telephonic communication between Berlin and Sweden extends to Malmo, Lund, Helsingborg, Engelholm, Landskronen, Norrkoping, Trelleborg, and a few other places. It is, however, hoped that as the new cable between Fehmern and Laaland is connected with Berlin by a line through Mecklenburg, excluding Hamburg, it will be possible to obtain a good speaking connection between Berlin on the one hand, and Gothenburg and Stockholm on the other. Apart from this scheme, a direct means of telephonic communication is projected between Germany and Sweden. It is stated that Sweden wishes to be independent of the intermediary of the Danish cable in this direction, and would be glad to see the establishment of a direct telephonic cable between the German island of Rügen, and the south coast of Sweden. The execution of the scheme depends upon the proposals which Sweden may place before the German postal authorities, although technical difficulties have also to be taken into consideration. For instance, the distance between Rügen and the south coast of Sweden is about 62 miles, and the question is whether a telephonic connection by means of a submarine cable of that length would be possible. At present the postal authorities have a cable between the mainland and Heligoland, which represents a distance of nearly 47 miles, and conversation is satisfactory on this line. This being the case, hopes are entertained in Germany that success may attend the scheme for the laying of the longer telephonic cable between that country and Sweden, as already mentioned, and that it may also eventually result in the institution of a similar connection between England and Emden, so as to bring London and Berlin into speaking communication with each other.

Telegraphic Interruptions and Repairs:—

Cables.		Interrupted.	Repaired.
Curacao-Coro Curacao-La Guayra Curacao-Maracaibo	Closed..	Jan. 12, 1906 ..	..
Tarifa-Tangier		Jan. 18, 1904 ..	..
Port Arthur-Chifu (Closed)		Mar. 9, 1904 ..	..
Garachico-Santa Cruz		July 12, 1906 ..	..
Las Palmas-Arecife		Aug. 18, 1906 ..	..
Brest-Dakar		July 22, 1907 ..	..
Landlines.			
Puerto-Barrios		Aug. 2, 1902 ..	..

Telephone Rates.—The agitation against the message-rate system continues, and the Association of Chambers of Commerce of the United Kingdom recently forwarded to the Postmaster-General and to the National Telephone Co. a memorial protesting against the change. Both have replied, pointing out the fact that the new system is equitable and, indeed, the only possible one under modern conditions.

Telephotography.—It is reported that Mr. E. Belin, a French engineer, has developed a system of transmitting photographic images by telegraph, which is shortly to be tested on a long line. A correspondent of the *Pall Mall Gazette* explains that in the Belin process the photograph to be transmitted is a carbon print in relief, which is mounted on a rotating cylinder; a finger working in contact with the print and following its contour operates mechanism which introduces resistance into the line circuit, thus varying the position of the mirror of a Blondel oscillograph. Light reflected from the mirror is focused upon a hole $\frac{1}{6}$ mm. in diameter, which is in contact with a sensitised film mounted on a second cylinder, rotating synchronously with the first. The intensity of the light falling upon the hole is varied in accordance with the position of the mirror, with the aid of a screen of graduated tone, thus reproducing variations of tone corresponding to the variations of relief of the carbon print at the sending end. By reversing the scale of tones, the record can be made either positive or negative at will.

Wireless Telegraphy.—The French Press reports that an improvement has been effected in wireless telegraphy on French warships, and that the cruiser *République* has maintained communication with the *Jules Ferry* over a distance of 468 miles. Communication was also effected between the *République* and the Eiffel Tower in Paris, 500 miles away, in both directions.

The first official Commonwealth-owned and controlled wireless telegraph station in Australia will be between Queensland and British New Guinea (Papua). The Postmaster-General has given instructions to call for tenders. The tenders will be open to the world, but companies submitting their systems will have to sell them right out to the Federation, as the Government is determined that no private monopoly shall be given a footing in the Commonwealth.—*Mining Standard.*

Reuter reports that the Marconi station at Siasconset, U.S.A., has been destroyed by fire.

CONTRACTORS' COLUMN.

Openings for New Business.

ABERTILLERY.—New school for the U.D.C. (£5,700).

ALDERSHOT.—Rebuilding Princess Hotel for Crowley & Co., Ltd. Friend and Lloyd, architects, Grosvenor Road, Aldershot.

BARNES (Surrey).—Important additions to the U.D.C.'s hospital (£3,300).

(Surrey).—Business premises in Lower Richmond Road for D. Brittain.

BEDFORD.—Telephone and E.L. installation at the new offices for the B.G.

BOURNEMOUTH.—Proposed new Salvation Army Hall (£800). O. Archer, architect; S. Taylor, builder.

BURNHAM (Somerset).—New Technical schools (£800).

CARLISLE.—Bungalow residence at Cote Bank, Skinburness. H. H. Hodgkinson, architect, Carlisle.

CO. DURHAM.—New public schools at Cornsay Colliery, Benfieldside, Trindon Grange, New Brancepeth, North Brancepeth, Whitton, Hetton-le-Hole, and Cassop, for the C.C.

CONSETT.—New Primitive Methodist Church in Delves Lane (£6,000).

CROMER.—New Council offices. R. Croome, surveyor to the U.D.C.

DUNDEE (Bridge of Earn).—Proposed hall and institute (£1,550). G. P. K. Young, architect, Perth Chambers, 42, Tay Street, Perth.

EDINBURGH.—Fine art building at Laughton Park. J. Marchbank, 45, York Place, Edinburgh.

EPSOM.—Bungalow residence on Epsom Downs for E. R. Cason.

FRIERN BARNET.—Private residence (£980). A. Collins, Highgate, builder.

GLASGOW.—Alterations and extensions at the Cancer Hospital, Garnet Hill (£23,360).

HARPENDEN.—Additions and alterations to Moreton End for Rev. A. G. Bowling.

HARROGATE.—Important additions to Dirlton Private Hotel for I. W. Rymer. J. Whitehead, architect, Herald Buildings, Harrogate.

HASTINGS.—Studio at 8, West Hill, for Sir H. Burdett, K.C.B. Wm. Gibbin and Son, builders.

HASTINGS.—New Congregational Schools. T. W. Elworthy, architect, 81, London Road, St. Leonards.

HAYWARD'S HEATH.—Business premises for C. W. Wood (£1,650). H. Finch, builder, Hayward's Heath.

HEBBURN-ON-TYNE.—New mission school-room in Jervis Street in connection with the Wesleyan Methodist Church (£500).

HEMEL HEMPSTEAD.—New factory (£40,000). W. T. Walker, architect, 40, Finsbury Square, London, E.C.

HERTFORD (Hertingfordbury).—Important additions to the Mansion at The Park. Powell & Co., architects, 89, Chancery Lane, London, W.C.

HITCHIN.—Development of Lovell Estate (20 acres) for building residences. Alfred Fowler, builder, Hitchin.

HORWICH (Lancs.).—Rebuilding Prince's Theatre. Mr. Patterson, owner, Bolton.

HUDDERSFIELD (Fartown).—New Liberal Club premises. Stocks and Sykes, architects, St. Peter's Street, Huddersfield.

HULL.—New school for St. Mary's Church, Sculcoates. Wellstead, Dossor and Wellstead, architects, Waterloo Chambers, Hull.

Additions to the Grammar School in Leicester Street. J. H. Hirst, city architect, Town Hall, Hull.

HULME (near Manchester).—Improvement of Holy Trinity Church.

HYDE.—Motor-shed at Godley Works for the Maypole Dairy Co.

ILFORD.—Important extensions to the General Post Office.

ILKLEY.—New public school for the West Riding of Yorks C.C. J. Vickers Edwards, architect, County Hall, Wakefield.

IRLAM (Lancs.).—New wall-paper mill in Dean Road.

KIRKBURTON.—New elementary school for the West Riding of Yorks C.C.

KIRKHEATON.—New public school for the West Riding of Yorks C.C.

LANCASTER.—New General Post Office for H.M. Office of Works.

LEEDS (Crossgates).—Proposed new church at Manston (£4,500).

LEVEN (Fife).—Higher-grade school. Ex-Provost White, chairman of Board.

LLANDRINDOD WELLS.—Pavilion and pump room in the Recreation Ground (£5,000); municipal buildings (£1,500); Free Library (£1,500), for the U.D.C.

LLANTRISANT (Glam.).—Important additions to Pontyclun Engineering Works for Mountford Phillips & Co., Ltd. W. B. Jones and Peregrine, architects, Bank Chambers, Station Road, Port Talbot.

LONDON (Wandsworth).—17 houses in Swaby Road. Holloway Bros., 19, Belvedere Road, S.E., builders.

(Wandsworth).—Alterations and additions to Richmond House, Wimbledon Park Side. E. P. Bulled & Co., 8, Cromwell Road, Croydon, builders.

(Marylebone, W.).—Alterations to school (£1,148). Thompson and Beveridge, 151, Harrow Road, W., builders; T. J. Bailey, architect (Education), L.C.C., Spring Gardens, S.W.

(Lower Tooting, S.W.).—Baptist chapel. Rev. J. Felmingham, minister-elect.

(Deptford).—Workshop in Silwood Street. J. Appleby & Sons, Stamford Street, S.E., builders.

(Camberwell, S.E.).—Hall at Nunhead. Secretary, Salvation Army Headquarters, Queen Victoria Street.

(Uxbridge).—School (600 places). Lee and Farr, Slough, architects; H. Flint, Wycombe, builder.

(Holborn).—Restaurant, shops and offices on sites of Nos. 20, 21, 22, 23, Holborn. Palgrave & Co., 28, Victoria Street, S.W., architects.

(Wandsworth).—Addition to 292, Streatham High Road. Treacher and Son, 73, Moorgate Street, E.C., architects.

(Bermondsey).—Rebuilding "Waterman's Arms." W. Stewart, 4, Aldgate, E., architect.

(W.C.).—Alterations and additions to Lyceum Theatre. E. Bates, 24, Finsbury Square, E.C., architect.

(Kennington, S.E.).—Conversion of factory into temporary workhouse. Clerk to Lambeth Guardians, Brook Street, S.E.

(Bermondsey, S.E.).—Factory in Sun Street. Barlow & Roberts, 15, Red Cross Street, S.E., builders.

(Bermondsey, S.E.).—Disinfecting station at Neckinger. R. J. Angel, borough surveyor, Spa Road, S.E.

(Brixton, S.W.).—Building on site of 21 to 27, Cranmer Road. C. W. Stephens, 49, Hans Road, Brompton Road, S.W., architect.

(Kennington, S.E.).—Building on site of 71, Upper Kennington Lane. P. Dollar, 7, Arundal Street, W.C., architect.

(Limehouse, E.).—Manual training centre (£1,457). W. Lawrence and Son, Waltham Cross, builders; T. J. Bailey, architect (education), Spring Gardens, S.W.

(Kennington).—School for defective children (£4,937). Rice and Son, 15, Stockwell Road, S.W., builders; T. J. Bailey, architect (education), L.C.C., Spring Gardens, S.W.

(W.).—Shops in Earl's Court Road. Ford & Walton, Kilburn, builders.

(Lewisham, S.E.).—Twenty-three houses in Murkirk Road. Norfolk & Prior, Catford, architects.

(Lewisham, S.E.).—Dyeing and cleaning works in Leahurst Road for T. Stow & Co., Ormside Street, Old Kent Road, S.E.

(Lewisham, S.E.).—Church in Courtrai Road. Joseph Dorey and Co., Brentford, builders.

(Lewisham, S.E.)—Offices and shops in High Street. H. L. Holloway, Union Works, Deptford, builder.

(Streatham, S.E.)—Alterations to 71, Mitcham Lane, for London Joint Stock Bank, Ltd. R. Creese Harrison & Son, 103, Cannon Street, E.C., architect.

(Tooting).—Skating rink. E. L. Ellis, 58, Rossiter Road, Balham.

(Brixton).—Buildings on north side of Cornwall Road. Fasnacht and Beale, 17, Old Queen Street, E.C., architects.

(Edgware Road).—Extensive alterations to Hodgkinson's drapery premises. Wm. Johnson & Co., Ltd., Wandsworth Common, builders.

(Tulse Hill).—Development of estate for building between Tulse Hill and Trinity Road. Herring, Son & Daw, 312, Brixton Hill, surveyors.

(Hammersmith).—Building in King Street. J. W. Stonhold, Birkbeck Bank Chambers, Southampton Buildings, W.C., architect.

LUTON.—New school (accommodation, 1,000) in Dunstable Road for the T.C.

MANCHESTER (Hulme).—New Congregational Church in connection with Manchester and District Congregational Board.

MIDDLESBROUGH.—New co-operative stores and house. W. G. Roberts, architects, 61, Albert Road, Middlesbrough.

MORECAMBE (Heysham Harbour).—Extensive works at the harbour for the Midland Railway Co. Mayoh & Haley, builders, Fulham, W.

NEWCASTLE-ON-TYNE.—Bakery, stables, and residence at Benwell, for J. Jennings. Shewbrooks & Hodges, architects, 24, Grainger Street West, Newcastle-on-Tyne.

NEWTON-IN-MAKERFIELD (Lancs.).—New public library in Crow Lane, Earleston, for the U.D.C. J. Myrtle Smith, architect, 5, Milton Chambers, 128, Cheyne Walk, Chelsea, S.W.

NORTHAMPTON.—New factory for J. Masters, manufacturer, Roade. A. M. Dunham, builder, Commercial Street, Northampton.

PARKSTONE (Hants).—Three shops and residences for J. J. Norton. Smart and Wyeth, architects, Bank Chambers, 220, Ashley Road, Parkstone.

PERTH.—Proposed new school (£15,000). G. P. K. Young, architect, Perth Chambers, 42, Tay Street, Perth.

PETERBOROUGH.—Villas on Eastfield Road, Peterborough. T. G. Stallbrass and Sons, architects, North Street, Peterborough.

PRESTON.—New Church Institute at Lostock Hall. J. Dewhurst, builder, Preston.

RAMSGATE.—Reconstruction of the amphitheatre (£5,000).

ST. ANNES-ON-THE-SEA.—New Imperial Hydro (150 bedrooms). J. D. and T. J. Mould, architects, 52, Queen Victoria Street, E.C., and Walmersley Road, Bury.

New Conservative Club premises (£2,500). Winstanley, architect, St. Annes.

SEAHAM HARBOUR.—New central station for the North-Eastern Railway Co.

SHANKLIN.—Pump-room at the baths at Royal Spa Hotel for the Hotel Co.

SOUTHEND.—Business premises, motor garage, warehouse, &c., West Road, for J. G. Dinn.

Extensions to the sanatorium for the T.C. (£8,000).

Business premises, bakehouse, &c., Leigh Road, for E. Bridger and Son.

SOUTH MOLTON (Devonshire).—Proposed new parish room in Duke Street (£600). E. D. Groves, borough surveyor.

STOKE-ON-TRENT.—Extensions to cottage hospital, including new laundry, for the B.G. (£4,450).

SURREY.—Nine new schools and additions to one school. Architect to County Council, County Hall, Kingston-on-Thames.

SUTTON COLDFIELD.—New post office accommodation required. Postmaster, Birmingham.
TUNBRIDGE WELLS.—Winter Garden at Spa Hotel for the Spa Hotel Co., Ltd.
New factory in Upper Grosvenor Road for Baillie Mills, 124, Camden Road.
WALKDEN.—New mission church. Rev. W. M. Smith, vicar.
WARE (Herts).—Two bungalow residences at Wellpond Green, Standon, for F. Howard.
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WHITBY.—Conversion of Spring Hill House into secondary school for the North Riding of Yorks C.C.
WILLESDEN.—New school for mentally and physically unfit children for the District Council.
WILMSLOW.—New schools at Mottram, St. Andrew. Brown & Sons, builders, Wilmslow.
WINDSOR.—Rebuilding the Fawn Hotel, for Burge & Co., Victoria Brewery, Windsor.
WITTERSHAM (near Rye).—Important additions to Wittersham House for the Hon. Alfred Lyttelton, K.C., M.P., E. L. Lutyens, architect, Bloomsbury Square, London; Geo. Browning, builder, 26, St. George's Place, Canterbury.
WOLVERHAMPTON.—New Kinver Waterworks, Liesdon. S. R. Lowcock, engineer, Temple Courts, Temple Row, Birmingham, and 50, Queen Anne's Gate, Westminster, S.W.
YORK (Oswaldkirk).—Important additions to Oswaldkirk Hall, for Col. Benson.

CONTRACTS OPEN and CLOSED.

OPEN.

Argentine Republic.—Offers are being invited by M. Richard R. Lodola, c/o La Banque Espagnole du Rio de la Plata, 32, Avenue de l'Opera, Paris, for the construction of an electric tramway on the Urdaniz route in Buenos Ayres and the supply of the necessary material.

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Australia.—South Australia. January 8th, 1908. One common-battery switchboard and 3,000 subscribers' telephones. Commonwealth Office, 72, Victoria Street, S.W.

Melbourne.—80 A.C. flame arc lamps for the City Council. See "Official Notices" November 1st.

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(*Continued on page 857.*)

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(*Continued on page 857.*)

HORNSEY NEW TELEPHONE EXCHANGE.

By GEORGE BALCHIN.

A new common battery telephone exchange, with a present equipment for 2,700, and an ultimate capacity of 5,400 subscribers, was opened by the Post Office at Hornsey on the 7th inst. The premises, centrally situated in the Broadway, Crouch End, are entirely new, having been specially designed by the Post Office to meet the requirements of an up-to-date telephone exchange. The building covers an area of about 3,700 sq. ft.—excluding spacious stores and yard accommodation—and is of two floors only. The ground floor is appropriated for engineers' offices, linemen's quarters, apparatus and power room, and accumulator room. The upper floor accommodates the switchroom, operators' dining and cloak rooms, kitchen, &c. The building has been carried out on the hot-water system. In addition to the front stone staircase, there is, at the back of the building, an iron staircase running externally from the ground line to the roof, passing on the way an emergency exit from the switch-room. There is thus, in case of fire, a ready means of access either to the ground or to any part of the roof.

Fig. 1.—Interior of Switch Room.

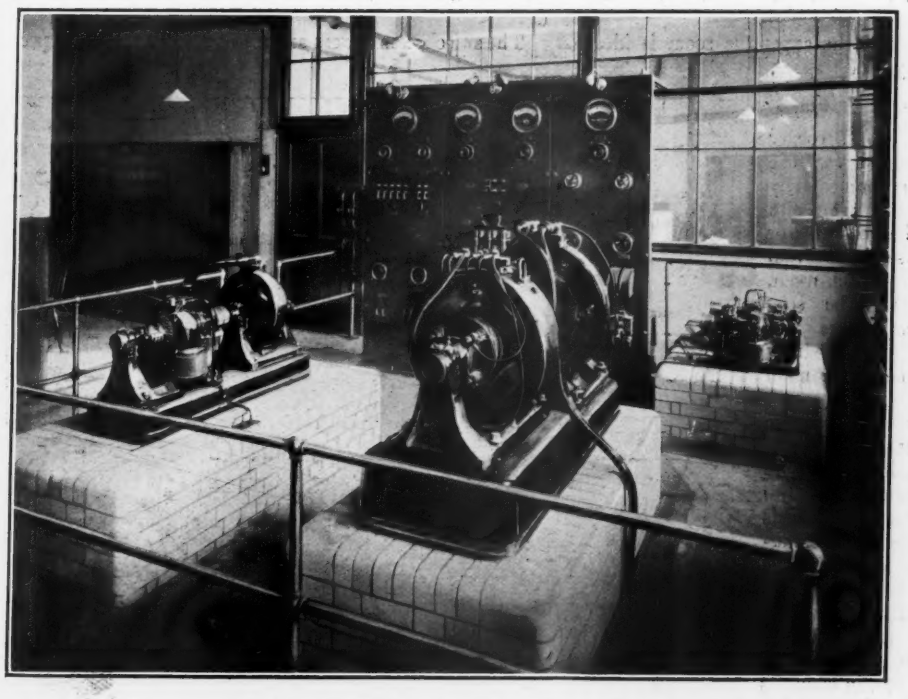

Fig. 2.—Motor-Generators and Power Board.

The cable leading-in chamber is situated immediately below the test (or apparatus) room; 780-wire main cables, of the air-space paper-core type, are led into this chamber, whence they are continued to the main distributing frame on the ground floor, immediately above, by means of silk and cotton-insulated cables, solid joints being made between the two types of cable. On the horizontal side of the main distributing frame the cables are waxed and laced out in the usual manner, and the wires are led through open fuses, mounted on porcelain blocks, fixed to the horizontal bars of the frame. Thence they are taken, by means of flame-proof "jumper" wires, direct to the arrester bars on the vertical side. A view of the porcelain blocks on the

finished off with a view to future extension, if necessary, by means of the addition of a third floor to the front portion of the premises. Fireproof materials have been used wherever possible throughout the construction, and all heating is

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horizontal side of the main frame is shown in the illustration below. Each main cable takes a separate bar on the frame, starting from the bottom and working upwards, and, as each bar has a capacity for 720 lines,

Fig. 3.—Main Distributing Frame, showing Fuses.

the 390-pair cables extend a little over half-way along. Thus, one-half of the frame will be utilised first, and ample space has been left at the back of the existing cables to carry other main cables along for the purpose of serving the remaining half of the frame.

The general arrangement of the apparatus room is ideal in respect of economy of space, whilst leaving ample provision for the necessary testing and maintenance work to be carried on. A railed-off corner of this room is appropriated for the power board and machinery, immediately behind which, and separated therefrom by a glass partition, is the accumulator room. An iron staircase leads from the test-room to the switch-room, directly above, and it will be seen therefore, that, for compactness and general convenience, the exchange may be regarded as a model one. The main and intermediate frames, and apparatus racks in the test-room, with the single exception of the relay rack (an extension of which will be required later) are designed for the full capacity of 5,400 subscribers. The various power leads from the power board to the accumulators, fuse panel, and machines, the earth leads from the relay and meter racks and main distributing frame, the battery leads feeding the resistance lamp cabinet, and the leads to the engineer's desk, are all run in conduits and pipes, built into the floor during the construction of the building.

The secondary batteries are three in number, two of which are of 24-volt and 500-ampere-hour capacity at the nine-hour rate, ultimately to be increased to 1,020 ampere-hours at the nine-hour rate. These two batteries are for the general working of the exchange alternately. The third battery, of 30 volts, and having a capacity of 60 ampere-hours at the nine-hour rate, is for the purpose of providing the comparatively high voltage necessary for the working of the subscribers' meters, and is also utilised for the tone test primary circuit. All the cells are of the Chloride S.M. type.

Two charging motor-generators are installed, both designed to run from the Hornsey Borough Council's lighting supply mains, one for 480 volts and the other for 240 volts. In each case motor and generator are mounted on a common bedplate. The armatures of the generators are provided with a large number of separate windings and commutator segments, in order to allow the batteries to be charged and discharged simultaneously without unduly interfering with the working of the exchange, and also to permit of the exchange being worked directly from the machines, should such necessity arise through the failure of the batteries. The output of the larger machine is 175 amperes at 30 volts (at 1,200 R.P.M.), and that of the smaller machine is 50 amperes at 30 volts (at 1,700 R.P.M.). Circuit-breakers, arranged to open the circuit with "reverse" or "overload" current, are inserted in the charging leads of the two 24-volt batteries. Fig. 2, p. 853, gives a general view of the power plant, with the battery room beyond.

Two ringing motor-generators are also provided, one arranged to run from the 240-volt mains, and the other from the 24-volt battery. Both are equipped with the usual attachments of make-and-break segments, giving the necessary interruptions for junction ringing and for the various tone signals. Each gives an output of 2 amperes at 75 volts.

The power board is equipped with the usual motor-starting and battery-charging switches, voltmeters, ammeters, &c. A switch is provided, by means of which the individual reading of any cell of the 24-volt batteries may be taken, and a recording ammeter keeps the output of current on the exchange, from the 24-volt battery, constantly under review. The fuses for the high-voltage supply mains are mounted on a small slate panel, forming an extension of the power board. The use of the Helsby Cable Co.'s patent "porcelain sealing ends," for the prevention of surface leakage, has been made general throughout the equipment, every power cable having been finished off at each end by means of one of these excellent insulating devices.

The switchroom covers an area of 2,400 sq. ft. Its present

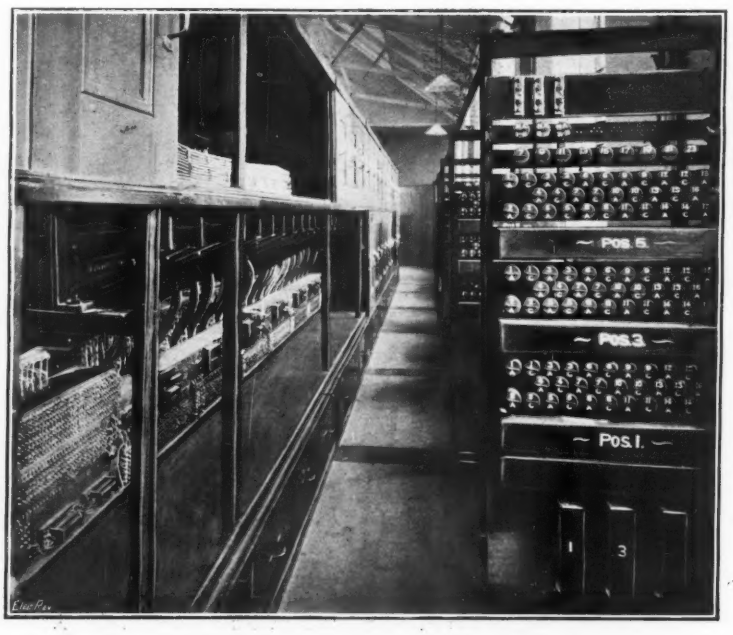

Fig. 4.—Back of Subscribers' Board, and Relay Racks.

equipment consists of 15 "A," 9 "B," 1 electrophone and 1 "test and plugging-up lines" positions, these forming half the final equipment (fig. 1, p. 853). One supervisor's and three monitors' desks are at present installed. The interior of

the sections has been carefully designed with a view to minimising fire risks, sheet-iron and uralite playing a prominent part in their construction. All apparatus is mounted external to the sections, on special iron apparatus racks, an arrangement which greatly facilitates the work of maintenance, besides reducing the risk from fire. Lead-covered cables are used between the sections and the apparatus racks, all ringing leads being taken in separate cables as a safeguard against inductive disturbances in adjacent speaking circuits.

The sections are of the nine-panel three-position type, the subscribers' multiple extending over nine, and the outgoing junction multiple over six panels. The latter multiple is of 300-line capacity. It may be mentioned that separate cables are provided for the subscribers' multiple on the subscribers' and junction boards respectively, the common point for both being the horizontal side of the intermediate distributing frame.

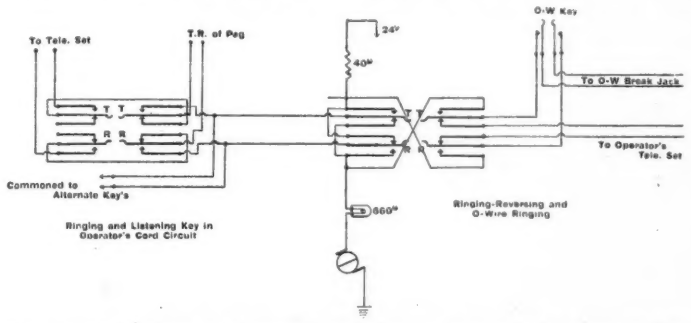

FIG. 5.—CONNECTIONS OF RINGING-REVERSING AND ORDER-WIRE RINGING KEY.

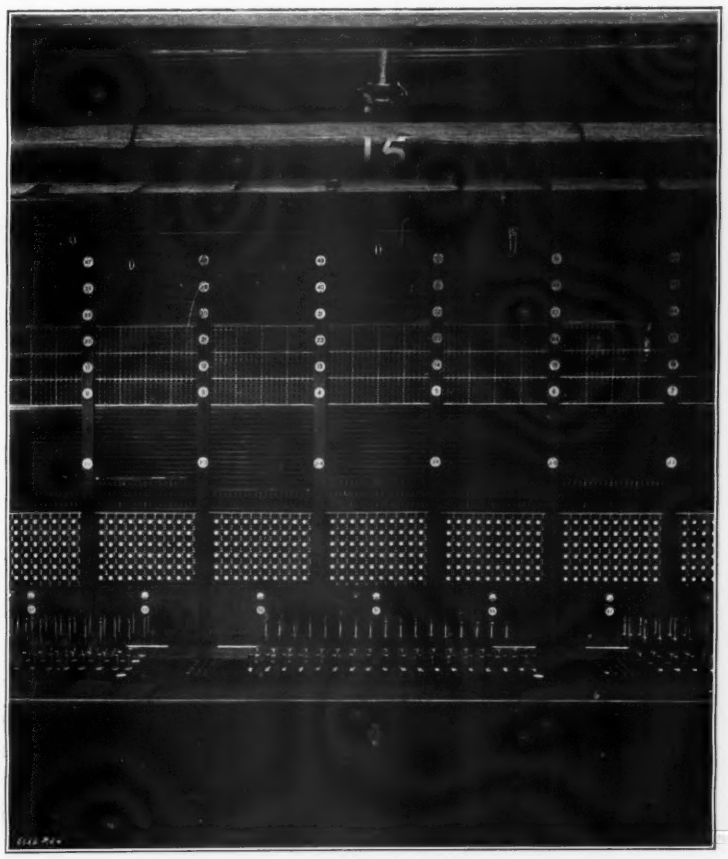

FIG. 6.—SUBSCRIBERS' MULTIPLE.

Party-line working is limited to two subscribers per line, this restriction resulting in a great simplification of the keyboards. On the subscribers' board one extra key per position (see in the adjoining view at the extreme right of the 17 speaking and ringing keys) suffices to provide the necessary facilities for ringing "Y" subscribers; whilst on the junction side, a two-party line machine ringing key per cord (red and black plungers) is used. The object in each case is simply to provide a means of reversing the direction of the ringing current in the case of the "Y" subscriber. Combined with the "ringing-reversing" key already mentioned on the subscribers' board, is an "Order wire ringing" key, one lever operating both keys. The function of the latter is to enable the operator to ring on the call wires during the slack periods of the day. As will be seen from the accompanying figure, which gives the full connections of the "ringing-reverse, and order-wire ringing" key, the ringing circuit of each calling cord is made normally through the extra key, and when the latter is thrown in conjunction with any one of the cord-ringing keys, the effect is to reverse the generator connections, and, therefore, the direction of the ringing current. When the order-wire ringing key is thrown simulta-

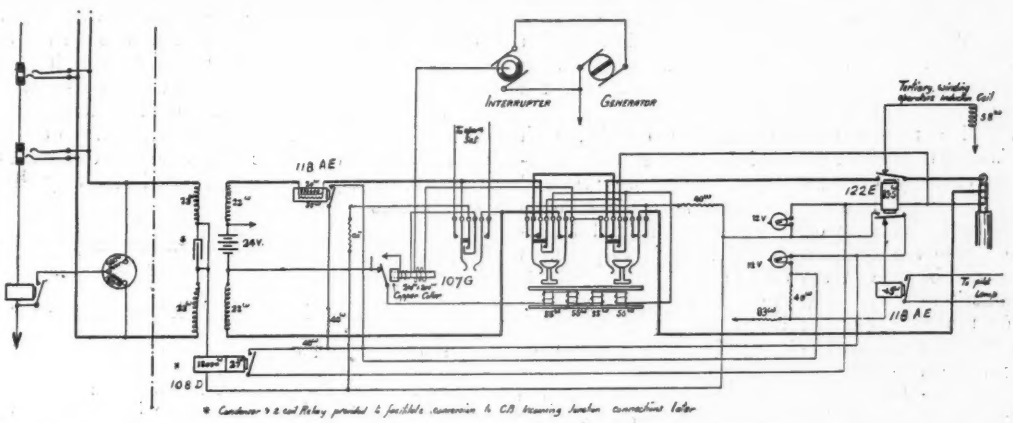

FIG. 7.—JUNCTION CIRCUIT INCOMING FROM MAGNETO EXCHANGE.

neously with the depression of a call wire button, ringing currents are sent out on the call wire.

The junction board is equipped with 26 cords per position. There are 9 positions, and consequently a total equipment for 234 incoming junction circuits. The wiring is arranged for a maximum of five call wires to be allotted to each operator. A view of a junction or "B" position is shown in the accompanying illustration. At one end of the junction board, next the cable-turning section, is the electrophone position, with facilities for giving 30 simultaneous hearings.

The usual method of wiring the junction circuits incoming from magneto exchanges has been departed from, with the result that the home supervisory lamp glows continuously until the subscriber responds, instead of being shunted as hitherto, when the machine ringing key is depressed. Also, it will be noticed in the diagram of connections given on p. 855, that the cut-off relay formerly associated with the shunting of the calling lamp has now been dispensed with, the desired result of shunting the lamp being attained by a general simplification of the wiring. A double-coil relay and a condenser have been introduced into the signal circuit in order to facilitate conversion to common battery working at a future date. In fact, the general trend of the present wiring is in the direction of approaching, as nearly as possible, the arrangement of the common battery incoming junction circuit.

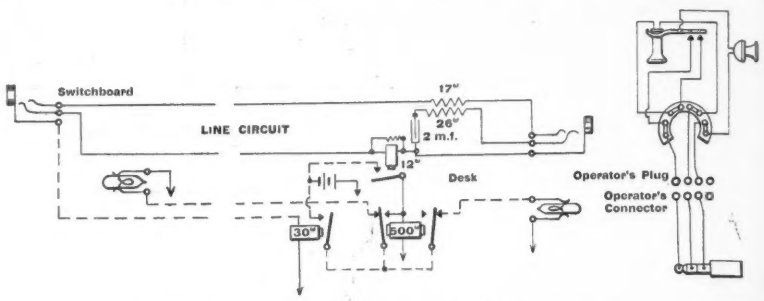

Fig. 9.—Connections of Line Circuit, Monitor's Desk.

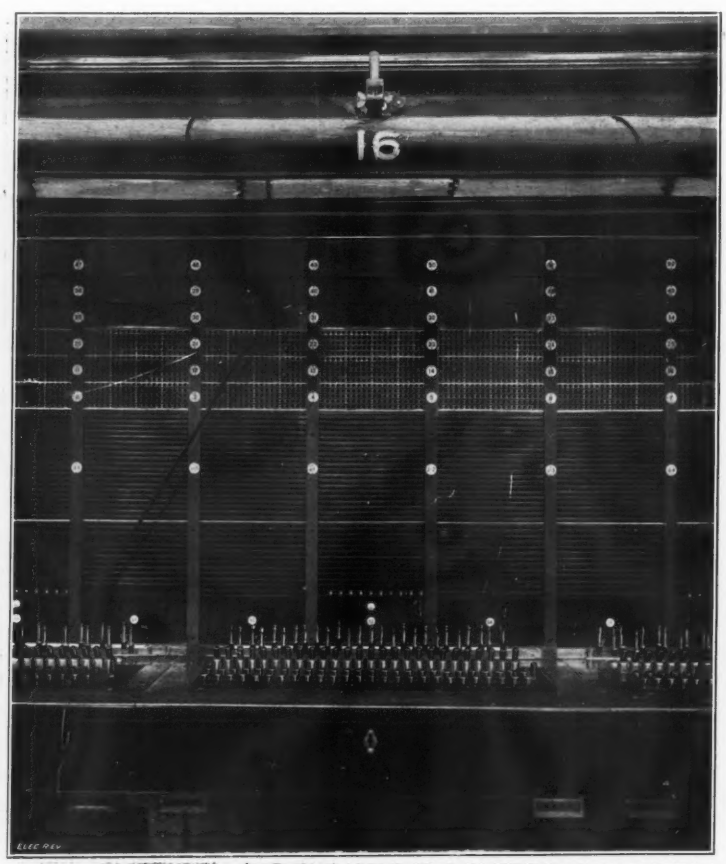

Fig. 8.—Junction Board.

On the supervisor's desk there are the usual facilities for observing the service of both incoming and outgoing operators. A special feature of the desk is the introduction of meter lamps in the observation lines, and the supervisor is, therefore, in a position to check every stage in the operating, from start to finish.

In addition to the usual observation circuits, each monitor's desk is provided with a line circuit to the switchboard, an ordinary subscriber's position in the "Home" section being allotted to each. A call for the monitor is indicated by the glowing of two lamps, one fitted immediately opposite the desk, over the multiple jack equipment on the switchboard, and the other, a special lamp of the "lighthouse" type, and therefore easily visible from a distance, on the monitor's desk itself. A special device has been introduced in this circuit for the purpose of clearing these two lamps, once for all, as soon as the receiver is lifted from the switch-arm. When the receiver is replaced, the clearing signal is observed by the operator upon her cord supervisory lamp in the usual course, but the two special lamps will not again light (even though the receiver be replaced upon the switch-arm), until the circuit is cleared and a fresh call put through. This obviates any confusion which might arise as to whether a call for the monitor is remaining unanswered, or a clearing signal being somewhat tardily dealt with at the board. The full connections of the circuit are given in the accompanying fig. 9. It will be noticed that upon the operator's plugging in, the 30ω relay is actuated, and a current flows, *via* the armatures of the 500ω cut-off relay, through both lamps in parallel. A call is thus indicated. Upon the receiver's being lifted, the 12ω line-circuit relay is energised and a path provided for the current through the 500ω relay coil to earth. This energises the cut-off relay, and its armatures are attracted, thereby cutting off both lamps from the battery. One of the relay armatures is, however, still made use of, in conjunction with an additional contact stop, to maintain the path of the current through the 500ω coil, when the circuit of the 12ω line relay is broken, due to the restoration of the receiver to the switch-arm. The cut-off relay thus remains energised from the moment that a call is responded to, till the circuit is cleared from the board.

The Western Electric Co. were the contractors for the installation, which was carried out in the very short period of 14 weeks.

The Constantinople Lighting Concession.—It is reported from Constantinople that the concession for the establishment of a central electric lighting station in that city has unexpectedly been granted to a Spanish syndicate, through the intermediary of the journalist Blasco Ibanez. The concession, it will be remembered, has been greatly in demand for a number of years past, the competitors being Germans, Americans and representatives of other countries.

CONTRACTS CLOSED.

(*Continued from page* 852.)

London.—SHOREDITCH.—The B.C. has accepted the tender of Messrs. J. & G. Weir, at £110, for a boiler feed pump for the electricity station.

STEPNEY.—The B.C. has received the following tenders for the supply of rubber cable:—

Baxter & Caunter	(provisionally accepted)	£269
F. A. Glover & Co.		329
W. T. Henley's Telegraph Works Co.		329
India-Rubber, Gutta-Percha & Telegraph Works Co.		337

Some time ago, in anticipation of a railway strike, the Council made an arrangement with Kaye, Son & Co., Ltd., to keep in hand at their Old Ford Depôt until the end of October, 1907, 1,000 tons of Norton Cannock nutty small coal, to the Council's order. Now that the strike has been averted, the Electricity Committee have decided in favour of 600 tons of coal being purchased, thus saving the option consideration of £49 10s. The price of the coal is 14s. 9d. per ton.

BERMONDSEY.—The B.C. has received the following tenders for the supply of 2,350 yd. of 2 × 2 × 1 sq. in. low-tension triple-concentric cable:—

Johnson & Phillips, Ltd.	(provisionally accepted)	£1,027
W. T. Glover & Co.		1,040
W. T. Henley's Telegraph Works Co.		1,045
Callender's Cable & Construction Co.		1,046
British Insulated & Helsby Cables, Ltd.		1,047
Siemens Bros. & Co.		1,055

WOOLWICH.—The B.C. received the following tenders for cable for additional feeder, to be laid from Beresford Square to the Hippodrome, in connection with the electricity undertaking:—

St. Helen's Cable & Rubber Co.		£734
Siemens Bros. & Co.		429
W. T. Glover & Co.		425
Johnson & Phillips		422
Callender's Cable & Construction Co.		420
Western Electric Co.		420
W. T. Henley's Telegraph Works Co.	(accepted)	414

The B.C. has accepted the tender of Steavenson & Co., at £77, for ironwork required in the reconstruction of boiler house roof at Woolwich works, and the quotation of the Oliver Arc Lamp, Ltd., for the supply of 10,000 pairs of arc lamp carbons, at £70 10s.

L.C.C.—The Highways Committee of the L.C.C. has resolved to extend the contract with Messrs. Heenan & Froude, Ltd., to include the supply of a car traverser for the first portion of the Bow tramway car-shed, at a cost not exceeding £735.

Moscow.—It is stated in the daily Press that Messrs. Bruce Peebles & Co., Ltd., have obtained the contract for the electrification of the Moscow tramways, at a cost of £2,000,000.

FORTHCOMING EVENTS.

To-day's Events (Friday, November 22nd).—At 5 p.m. At the Royal College of Science. Meeting of the Physical Society.

Saturday, November 23rd.—At 10 a.m. Junior Institution of Engineers. Visit to the Royal Arsenal, Woolwich.

At 11.30 a.m. Institution of Electrical Engineers. Students' Visit to the *Daily Telegraph* Printing Works, Fleet Street, E.C. Meet at the above works.

Monday, November 25th.—At 7.15 p.m. At the University, Sheffield. Institution of Electrical Engineers (Leeds Section). Mr. W. H. F. Murdoch on "Magnetic Testing of Iron."

Tuesday, November 26th.—At 7.30 p.m. At the University (Physical Laboratory), Manchester. Manchester Section of the Institution of Electrical Engineers. Mr. H. W. Wilson on "Further Remarks on the Electrical Operation of Textile Factories."

Wednesday, November 27th.—At 8 p.m. Society of Arts, John Street, Adelphi. "The Franco-British Exhibition," by Sir John A. Cockburn, K.C.M.G.

Thursday, November 28th.—At 8 p.m. At the Institution of Civil Engineers. Institution of Electrical Engineers. Dr. Robt. Pohl, paper on "The Development of Turbo-Generators."

Friday, November 29th.—At 8 p.m. Society of Arts, John Street, Adelphi. "The Hygiene of Work in Compressed Air (Diving, Caisson Work, Sub-Aqueous Tunnelling, &c.)," by Mr. J. S. Haldan, M.D., F.R.S.

Saturday, November 30th.—At 7.30 p.m. At the College. Glasgow and West of Scotland Technical College Scientific Society. Mr. P. J. Mitchell on "The Utilisation of Exhaust Steam in its Various Applications."

ELECTRICAL ENGINEERS, R.E. (VOLS.).

The following orders are issued:—

Monday, November 25th.—"A" Company. Technical drill, 7 p.m.

Tuesday, November 26th.—"B" Company. Recruits (infantry drill), 6 p.m.; technical drill, 7 p.m.

Wednesday, November 27th.—"C" Company. Technical drill (Hop. Cup), 7 p.m.

Thursday, November 28th.—"C" Company. Recruits (infantry drill), 6.30 p.m.; technical drill, 7 p.m.

Friday, November 29th.—"D" Company. Technical drill, 7 p.m.

Saturday, November 30th.—"D" Company. Technical drill (Hop. Cup), 3 p.m.

(Signed) J. H. S. PHILLIPS, Capt.,
Acting Adjutant.

NOTES.

International Electro-Technical Commission.—The preliminary meeting of the above Commission was held in London in June, 1906, at which delegates from some fourteen countries were present. The Rt. Hon. Lord Kelvin, P.C., O.M., was elected the first President and Colonel R. E. Crompton, C.B., Honorary Secretary of the Commission. A set of proposed rules relating to the general organisation of the Commission was drawn up and adopted subject to ratification by the authorities who had appointed the delegates. These rules have been practically accepted by all countries, and there is therefore little doubt of their being finally adopted at the first meeting of the Council, which, we understand, is likely to be held next Summer. Broadly speaking, the rules are based upon all countries being on an equal footing with equal taxation and equal voting power; they also provide for the manner in which the recommendations are to be arrived at and place the affairs of the Commission and the method of carrying out its objects in the hands of a representative Council, consisting of the President of the Commission, the Presidents of the Local Committees, who are Vice-Presidents of the Commission, ex officio, one delegate from each of the Local Committees and the Honorary Secretary. The general objects of the Commission are set forth in the following resolution, adopted by the Chamber of Government Delegates at the Electrical Congress held at St. Louis in September, 1904:—

"That steps should be taken to secure the co-operation of the technical societies of the world by the appointment of a representative Commission to consider the question of the standardisation of the Nomenclature and Ratings of Electrical Apparatus and Machinery."

We understand that up to the present time Local Committees have been appointed in Austria, Belgium, Denmark, England, France, Germany, Hungary, Mexico, Sweden and the United States; and that the question of appointing a Local Committee is also being considered in Australia, Canada, Japan, New Zealand, Russia, South Africa and Switzerland.

In a movement of this nature progress must necessarily be slow, but the fact that so many countries have already appointed Local Committees is not only very gratifying, but shows the interest taken in electrical standardisation throughout the world.

From the commencement, the Institution of Electrical Engineers has taken a very prominent part in the matter, and not only has it defrayed the preliminary expenses, but it has granted a substantial loan to the Commission in order that no financial difficulties should hamper the work of organisation during the first year, which action has been much appreciated by all concerned. The success with which the movement is meeting on all sides will not, however, necessitate any great inroads being made into the funds placed at the disposal of the honorary secretary by the Council of the Institution.

At the end of last year the British Local Committee appointed a Sub-Committee on Nomenclature, under the chairmanship of Mr. A. P. Trotter, the electrical adviser to the Board of Trade. This Sub-Committee is now engaged in drawing up a list of terms with their explanations, in general use in the electrical industry, and the Council of the Commission, we understand, will most probably publish a glossary of electro-technical terms in English and French, the languages in which all reports of the Commission are to be published. Under Nomenclature is to be included the question of Symbols, which will be taken up at a future date. When the Local Committees in the different countries have settled down to work, the British Local Committee, we understand, will appoint a Sub-Committee on Electrical Machinery and Apparatus to consider in particular what matters can be brought to the notice of the Commission, with a view to possible International agreement. The British Local Committee is working in conjunction with the Local Committee of those countries taking part in the labours of the Commission, and the secretaries of the Local Committee are kept *au courant* through the medium of the central office now established in London at 28, Victoria Street, Westminster, the secretarial work being in charge of Mr. C. le Maistre, A.M.Inst.C.E., the acting secretary to the Commission, to whom all inquiries should be addressed.

On the Promotion of Employés.—Wisdom is of the gods, but sometimes it is vouchsafed unto men. On the subject of promotion much has been written, said and thought, but a lot of it has been distinctly personal. There is nothing that produces a critical examination into the mental and moral attributes of an employer more than the refusal to grant a rise in wages, and the distinct gain to the community that would otherwise occur from the free expression of opinion is somewhat marred by the virulence of the language employed. It is, therefore, somewhat refreshing to find a writer in *Cassier's Magazine* for September discussing the subject in an impersonal and calmly scientific manner, and the aforesaid gift of the gods seems to have descended upon this author.

The matter is taken up in an analytical style, which leaves no room for polemics. It is written, "As regards the employé, the writer proposes to consider the relative importance of the various qualifications for promotion, bearing in mind also the great differences which are created by the different professions and industries, although there is really more standardisation in this respect than may appear at first inspection. As regards the employer, the same factors will be considered, but from a different aspect ——." They usually are! And an ominous note is struck by the phrase "In all cases a ruling consideration will be that a modern business is a money-making concern and not a philanthropic institution." This is equivalent to a flourish of the scalpel in the surgery.

The essence of modern life is expressed in the dictum that "promotion by seniority possesses some good features, but not many, and where it is satisfactory it will generally be found that other factors are really responsible." Initiative is at a discount, mechanical work is induced, a premium is placed on incapability, and rigidity in classification into grades is produced. Civil Service departments, where seniority rules salary, are instanced as solemn examples of this evil, and the minds of shift engineers in municipal electricity stations may easily find themselves in syntony with these remarks—if they happen to be junior members of the staff.

An old-fashioned virtue is mentioned—that of honesty. It is not, however, with the unreserved conviction that it is "the best policy," but that "the truth is that, where honesty is all-important, then the honest man has a special opportunity; but where dishonesty is made difficult, then it is other capabilities which govern promotion." Obviously then, the politic thing for a subordinate to do is to carefully examine from what quarter or quarters he is likely to get kicked if he swerves from the path of rectitude, and then to exercise his ingenuity in finding devious paths unadorned with mantraps, preferring rather to trust to the brilliance of his other abilities than to lay the hand of injured innocence upon the heart of conscious rectitude. This morality does not fit in with the parson's sermon.

To the man who in his youth has been overdosed with good books and moral admonitions from maiden aunts, it is refreshing to find the following remarks anent orderliness, neatness, correctness and painstaking work:—"It very often occurs that the orderly clerk, or the splendid writer or the absolutely correct accountant is rather superfluous . . . . the man who is scrupulously exact in everything, sometimes superfluously so, is often too much concerned with details to be able to grapple with matters of serious importance and emergencies."

It is pointed out that there is reliability and reliability. An assistant who can work without supervision as to detail is one thing, the individual with narrow ideas, a tendency to labour over details and omit broader considerations as they are "not in his department" is quite another. "Thinking imperially" is a fine art not altogether to be associated with one eminent statesman.

That remarkably satisfactory word "gumption" is used with commendatory remarks. "Many a man with indifferent training or experience is really a better workman than men who have had the best of training and long experience, simply because he can use his brains to help his hands, and because he can see a little way beyond his nose." From this ascends a golden ladder to success. "A man possessing 'gumption' can deal with what comes before him, but an initiative man will often develop beyond that . . . . Originality again corresponds very closely with 'gumption' and 'initiative' but proceeds a step further. An initiative man can originate developments, but the man who possesses originality can often introduce a new method of doing things, a new system, or can effect improvement in existing methods and systems."

Added to all the above qualities, the candidate for promotion must have capability for supervision, management and control, and the saving grace of tact. Possibly a perusal of the list may lessen the wonder at his non-success in practical life of the man who has gained many diplomas and the benedictions of his college professor. The bread-and-butter virtues are apparently different from those inculcated in copy-book maxims.

Turning now to the way in which promotion actually takes place in business life, the following conclusions sum up the author's observations. For ordinary routine and mechanical work the promotion of employés is a general practice. For superior positions requiring knowledge of the methods and practices of a certain business as opposed to similar businesses in the same trade, promotion of employés is the best practice, but for superior positions where general trade methods and practices are required, the introduction of outsiders is often necessary. Honesty, conscientiousness and like virtues, while desirable, are not the prime virtues. Management, controlling capabilities, initiative and tact are often more important. Humanitarianism and regard for employés is good to a certain point, but may be carried to an extreme. Harmonious relations between employer, employé and co-workers should be aimed at. Initiative and originality should be encouraged. Community of interest of employer and employé should be striven for. If promotion is a recognised policy, it should be carried on with discretion having regard to the inherent qualifications of the candidate for the work. If it is not recognised as a policy, usual methods should not be departed from without very good reason. Specialisation is good, but it must not be made a fetish. Favouritism, influence, personal bias, prejudice, unreasonable selection and kinship or acquaintanceship as reasons for promotion simply spell incapacitation of the firm.

We recommend these analytical remarks with all humility to certain borough councillors who, perhaps, choose their municipal electrical engineer, and guide his hand in selecting his subordinates, without having read the pages of our contemporary. We hope that our action may do them good.

Etheric Magic.—According to the *Morning Post*, a Mr. Grindell Mathews, who has set up a "little wooden hut" on the roof of the Kursaal at Bexhill, is carrying on experiments with a view to demonstrating his ability to steer and explode torpedoes by means of electric waves. The inventor's chances of success may be gauged from the following quotation:—"There is the induction coil and, of course, a transmitter, but one's eye rested on a little oblong box with two copper cylinders on the top. Anticipating the question, Mr. Mathews remarked: 'That contains the secret of my invention.' With the receiving station similarly fitted up affinity is established. 'The negative and positive poles are brought together. My waves go out and return in circles through ether, and the principle adopted, namely, the transformation of ordinary electricity into electrical vibration, means that no other wireless apparatus can affect it in any way.' Mr. Mathews said that he could send a torpedo, fitted out according to his instructions, below, on, or above water, and that if it should happen to be caught in a net the operator would know at once by the transmitting instrument and by pressing one of a set of keys he could cause an immediate explosion." With truly commendable caution, for which we are grateful, the *Morning Post* representative concludes that "the worth of the invention has yet to be proved."

The Franco-British Exhibition.—French Manufacturers not Enthusiastic.—The Paris correspondent of the *Times* says that in the *Siècle* M. de Lanessan publishes urgent appeals to French manufacturers and merchants to participate on a large scale in the Anglo-French Exhibition. He thinks that his compatriots require some little encouragement to make a brave show. Among other things, it is stated that already the organisers of the Exhibition of 1908 have conceded the electric lighting of the Exhibition to French houses. He considers that it would be a grave and perhaps irreparable fault if French manufacturers were not to go to England *en masse*, and he calls upon the French Government to encourage them by the promise of recompenses.

Reuter's Bordeaux agent says that the Bordeaux Chamber of Commerce has granted a subsidy of 10,000 fr. to the Bordeaux Committee of the Franco-British Union to facilitate the participation of the department of the Gironde in this Exhibition.

Utilising Copper Blast Furnace Cases in Gas Engines.—A correspondent of the *Mining Journal* states that, as part of the general electrification scheme of their extensive copper mining and smelting works, the Mansfeld Co. have for some time past been utilising the blast furnace gases from the smelters at the Krughütte works for direct consumption in gas engines—the first application of this system apart from its well-known use in ironworks.

The blast furnace gas has a heating power of 650 calories per cb. metre—the proportion of carbon monoxide being 21·65 per cent.—and as the volume of gas amounts to about 21,000 cb. metres per hour, the available power from this source, when used direct in gas engines, is between 4,400 and 4,500 H.P. Allowance must, however, be made for the lessened output when any of the furnaces have to be cleaned, and also for variations in the calorific power of the gas, and, therefore, the mean of 2,700 H.P. is all that can be depended upon.

The furnaces are connected up to two gas mains—one about 62 in. diameter, the other 39½ in.—either of which can be disconnected for cleaning or repairs. Before reaching the engines the gas has to be freed from dust, for which purpose it is passed through counter-current washers by the aid of spiral blades rotating at a peripheral velocity of about 165 ft. per second. In passing through the apparatus the gas is brought into intimate contact with water, which is sprayed by the action of the blades and forced in the opposite direction to the flow of gas. After being dried, the gas, which now contains only about 0·003 grm. of dust per cb. metre, against 17 grm. in its original condition, is led to a gas holder capable of storing 18,000 cb. ft. of gas, whence it passes to the gas engines.

These are two in number, of the Oechelhäuser type, and each of 1,300 H.P., a third of equal capacity being in course of erection. The type in question is preferred for the conditions under which the plant is worked, the absence of valves minimising the wear due to the presence of dust in the gas. In fact, this wear is now so small that the engines can be run for many months in succession. Each motor is of the two-cylinder class, with fly-wheel mounted on a common shaft between the halves, and each develops 1,300 H.P. when running at 125 revolutions and driven by gas of the above-mentioned calorific power. The cylinders are water-cooled, the effluent water being pumped up into a cooling tower and thence returned to the supply tanks. The fly-wheels constitute the rotors of the three-phase Siemens-Schuckert generators, developing an output of 1,080 KW. at 3,000 volts.

French and English Post Office Methods.—The discussion now proceeding in Paris in regard to the delivery of English and other letters from abroad has induced a correspondent to draw attention to a contrast between the work of the French and the English Post Office officials. Our correspondent states that when he had an office in the City, the postmen succeeded in delivering to him letters from abroad which only bore his name and London, E.C., as his address. This was very good work for a mere individual. On the other hand, a letter which was recently forwarded from London to the Compagnie Française des Câbles Télégraphiques, with the address merely given as Paris, was sent back by the French postal authorities with the rubber stamp impression of "returned to England without a reason for non-delivery." It is extraordinary, our correspondent observes, that the postal authorities should not know the exact address in Paris of the identical company to which they themselves pay a subsidy of many thousand pounds per annum.

Proposed Motor Road.—Notice has been given that application is intended to be made to Parliament in the ensuing session for leave to bring in a Bill to incorporate a company, and to empower that company to make and maintain a motor road from Hammersmith to Slough. The application also includes the making and maintaining of a tramway or tramroad which will begin in Hammersmith and extend to Windsor. A further clause in the application deals with the acquisition of certain lands in connection

with the motor and tram roads, for the purpose of erecting generating stations, engine houses, garages, car-sheds, repair shops, &c., and to enable the company to purchase by agreement or acquire by compulsion certain lands containing 12 acres in the parish of Isleworth, county of Middlesex, for the purpose of erecting a station for the "generating, transforming, storing and supplying electrical energy, with all the necessary and subsidiary works and appliances."

Fatality.—Deputy-Coroner Dodds held an inquest at Wallsend-on-Tyne on 18th inst. concerning the death of Hanson Topham, 31, an electrical engineer, who was killed on 7th inst. by an explosion at Wallsend, where Messrs. McAlpine are building a tunnel in connection with the Carville electric power station. William Roberts, agent for Messrs. McAlpine & Co., said he was in charge of the contract at the Carville power station for the sinking of a shaft for making a tunnel under the bed of the River Tyne to carry cables across the river. The shaft was about 70 ft. deep, and compressed air plant, electrically driven, was used to enable the men to work in the shaft. On the date named he heard that there had been an explosion, and on going to the air-compressor house he saw the shaft had gone to pieces. Foul gas might have caused the explosion, but that afternoon there had been no traces of it. Andrew Reed, civil engineer, of Glasgow, thought there had been a subsidence under the air-lock, and that the weight had caused a strain at the junction of the air-lock and shaft, which, in turn, brought about a pressure of air and caused the explosion. Edward Tibbit, manager for Messrs. McAlpine, said he had had six years of shaft sinking experience. On the night of the 7th inst. he was talking to Topham when the explosion occurred. Witness remembered nothing after the explosion. He was unconscious for over an hour. The air compressors had been working all night with 27 lb or 28 lb. of pressure. He thought the explosion had been caused by foul gas. There were chemicals in the ground. The jury found that Topham met his death through injuries accidentally received by an explosion in the shaft, but there was not sufficient evidence to show how the explosion was caused.

London Power Supply Associated Companies and Municipalities.—A brief reference appears in our leaderettes to-day to the new Bill for which Parliamentary application has just been lodged bearing upon the future of the London power supply question. The following are some of the clauses included in the announcement, which appeared in full in the *Times* of Wednesday:—

To transfer to and vest in the Joint Committee or to provide for transferring to and vesting in the Joint Committee, the present stations of any of the London Electrical Supply Companies, or of the Local Authorities supplying electrical energy in the Administrative County of London or any parts of such stations . . . . or to provide for the leasing of any such generating stations . . . . to the Joint Committee on terms . . . . to confer powers on the Joint Committee to manage and control such stations or any of them . . . and to erect new stations and extensions of stations and works.

To enable the Joint Committee on the one hand, and any of the London electrical supply companies or of the local authorities supplying energy in London and the London County Council or any of those companies and bodies on the other hand, to enter into and carry into effect agreements for giving or taking a supply of electrical energy, the transfer to the Joint Committee of generating stations and works, the provision of new or enlarged generating stations, the transformation of electrical energy, the provision, laying down, maintenance and use of new electric lines or works, the use of existing electric lines or works, and the control, management or working by the Joint Committee of any generating stations of such other bodies or any of them or any parts thereof and to provide for regulating and defining the system and mode of supply whether by the Joint Committee or any such company or authority as aforesaid, and to confer powers for the purpose of carrying into effect any such agreement upon the parties thereto, and for the exercise by any one or more of such parties for or on behalf of the other or others of them within the districts of all or any one or more of them of any of the powers or rights applicable or existing in the district or districts of any one or more of them, and as to the appropriation and division of receipts arising under, and the provision of the moneys required for carrying into effect any such agreements.

To authorise the Joint Committee, within the area hereinafter defined, to sell and supply electrical energy in bulk to any company or body authorised under any Provisional Order or Act of Parliament to distribute electrical energy, and to enable such Committee to supply electrical energy for use upon or in connection with railways, tramways, canals, navigations, docks, waterworks, or other similar undertakings, whether within or without such area.

The area over which it is proposed that the powers of the Joint Committee should extend is as follows:—

The Administrative County of London and—

In Essex—

The County Borough of West Ham, the Borough of East Ham and the Urban districts of Barking Town, Walthamstow, and Leyton.

In Kent—

The Borough of Bromley and the Urban districts of Erith, Bexley, Footscray, Chislehurst, Beckenham and Penge and so much of the rural district of Bromley as is comprised in the parish of Mottingham.

In Surrey—

The County Borough of Croydon, the Boroughs of Kingston-upon-Thames, Richmond and Wimbledon and the Urban districts of Barnes, Ham, and the Maldens and Coombe and so much of the rural district of Croydon as is comprised in the parish of Mitcham.

In Middlesex—

The Borough of Hornsey and the Urban districts of Chiswick Acton, Willesden, Hendon, Finchley and Tottenham.

To empower the Joint Committee on the one hand, and any company, local authority, body or person authorised to supply electrical energy within the area hereinbefore defined; on the other hand, to enter into and carry into effect agreements for the supply by or to the Joint Committee of electrical energy in bulk to or by any such company, authority, body or person.

To impose obligations upon the Joint Committee to supply electrical energy in bulk and to fix and define the price at which, and the terms and conditions upon which the Joint Committee may be required to give such supply, and the Bill may provide for a differential price for energy supplied either in relation to the quality or quantity of the energy supplied or to the point at which the same is supplied, and will empower the Joint Committee to make and recover charges for the supply of electrical energy and for or in connection with the provision or supply or working of any engines, machinery, fittings or apparatus or work done in connection therewith or any services performed by them.

To empower and require the constituent companies or any bodies represented on the Committee to afford a supply of energy to the Joint Committee, and to determine or provide for determining the price at which and conditions upon which such supply shall be given.

To exempt the Joint Committee and their undertaking from all or any of the provisions of the Electric Lighting Acts, 1882 and 1888, and in particular to provide that the provisions of the said Acts with respect to the purchase of the undertaking shall not apply to any undertaking, property or rights of the Joint Committee; and if thought fit to define the terms upon which and to prescribe the authority or body by whom such undertaking may be purchased, and to provide for the exclusion from any undertaking in London purchaseable by any local authority under the provisions of such Acts of such portions of such last-mentioned undertaking as may then be in use by the Joint Committee, and for the purchase thereof by the Joint Committee, or for the transfer thereof from any local authority so purchasing to the Joint Committee, and to prescribe and define the terms and conditions of any such purchase or transfer.

To repeal or modify the provisions relating to the purchase of undertakings contained in the Electric Lighting Acts, 1882 and 1888, so far as such provisions relate to London, and to repeal or modify all or any special provisions relating to purchase of undertakings which may be contained in any Acts or Orders relative to the several London electrical supply companies, and to make other provisions in lieu of any provisions so repealed.

To impose obligations upon any of the London electrical supply companies with respect to the sale by those companies of all or any part or parts of their undertakings, and of any lands, property or works belonging to them respectively, and to impose similar obligations upon any local authorities supplying electrical energy within the Administrative County of London.

To confer powers upon the constituent companies or any of them to supply electrical energy to the Joint Committee and to any company, local authority or other authority owning or working any railway, tramway, canal, navigation, dock, waterworks, or other similar undertaking, whether such energy be used within or without the area of supply of the company giving the same.

To authorise the London electrical supply companies, the local authorities supplying energy in London, and the London County Council to enter into and carry into effect any agreement or agreements as between all or any two or more of them respectively for mutual assistance or for association in respect of the following purposes:—

The giving and taking of a supply of electrical energy and the distribution and supply of energy;

The provision of any new, enlarged or extended stations for the production and generation of electrical energy;

The provision, laying and maintenance of mains, cables, wires and works for connecting generating stations together or with any other stations or works, or for conveying or distributing electrical energy;

The taking over, management and working of the generating stations and of the whole or any part or parts of any electrical undertakings;

The appropriation and division of receipts arising under, and the provision of the moneys required for carrying into effect any such agreements;

Any matters or things incidental to or connected with any of the purposes aforesaid.

Football.—The G.E.C. want us to remind their friends that they are still running their football club, and that they have several vacant dates away. They would be very pleased to meet any team attached to another firm, in or out of the trade. So far the club has been very successful, having played eight matches, six of which they have won, one has been drawn and one lost, with a goal average of 34 for, and 18 against. Correspondence should be addressed to Mr. W. Maddams, hon. secretary.

Although sending their strongest available team to Herne Hill, the G.E.C. football club were beaten 5 goals to 1 by "Holliday Athletic." A correspondent says: "It was a good game, in which the half-backs and backs of the winners predominated, and gave a good lesson in following up their forwards, which we should like to see the G.E.C. defence do."

An interesting match of the Electric Supply Football League

will take place to-morrow (Saturday) at Greenwich, between teams representing the L.C.C. Tramways Power Station and the St. James Electric. The first meeting ended in a decisive win for the latter, but we are informed that, with a much improved team, the L.C.C. hope to reverse this result. The only other fixture in this month is at Willesden on November 30th, when the Metropolitan Electric will endeavour to secure their first win at the expense of the St. James Electric.

Fire at Ealing Electricity Works.—On 18th inst. there occurred at the Electricity Works, South Ealing, what might have proved a disastrous fire, but thanks to the prompt action of the works fire brigade, the flames were got under successfully before the engine room was reached. The damage is confined to the stores and offices. Nearly all the men employed in the station are members of the works brigade, and hydrants were playing on the fire within three minutes of its discovery. It was not necessary to call in the local fire brigade, and there was no stoppage in the supply.

Institution and Lecture Notes. — Institution of Electrical Engineers (Manchester Section).—The opening meeting of the Manchester Section was held on Tuesday evening, the 12th inst., when the chairman, Mr. M. B. Field, delivered his inaugural address. There was a good attendance of members, fully 120 being present. After the address there was a smoking concert which was greatly enjoyed.

Institution of Electrical Engineers.—At the meeting last week, Dr. Glazebrook announced the awards of premiums for papers read during the previous session. He then vacated the chair, his place being taken by the senior Vice-President, Mr. C. P. Sparks, and a vote of thanks, moved by Dr. S. P. Thompson, and seconded by Mr. W. M. Mordey, was cordially awarded to the retiring President. We regret to see, in one of our contemporaries, a letter, signed "M.I.E.E.," in which the conduct of the meeting by Mr. Sparks is severely criticised; and this is supported by editorial comments. We consider these criticisms entirely uncalled-for, as, in our opinion, the discussion was conducted with impartiality, and in accordance with the rules of the Institution; moreover, Mr. Sparks's own remarks, which we report on another page, were of considerable interest, and were not unduly lengthy.

The Royal Society.—Among the papers down for reading yesterday afternoon were the following:—

F. E. Smith, T. Mather, F.R.S., and Dr. T. M. Lowry. "On the Silver Voltameter. Part I: A Comparison of Various Forms of Silver Voltameters," by F. E. Smith; and a "Determination of the Electro-chemical Equivalent of Silver," by F. E. Smith and T. Mather, F.R.S. Part II: "The Chemistry of the Silver Voltameter," by F. E. Smith and T. M. Lowry. Communicated by Dr. Glazebrook, F.R.S.

F. E. Smith. "On the Normal Weston Cadmium Cell." Communicated by Dr. Glazebrook, F.R.S.

Dr. F. D. Chattaway, F.R.S. "On a Method of Depositing Copper upon Glass from Aqueous Solutions in a Thin Brilliantly Reflecting Film, and thus producing a Copper Mirror."

Dr. C. V. Drysdale. "On Luminous Efficiency and the Mechanical Equivalent of Light." Communicated by Prof. S. P. Thompson, F.R.S.

Junior Institution of Engineers.—On Monday last M. Gustave Canet, the new President, delivered his inaugural address, the subject being "Comparisons between French and English Artillery." Referring to the training and elevating mechanism of naval guns, the author stated that hydraulic power was employed for this purpose in the British Navy, while the French used electricity. The same difference existed in the case of ammunition hoists and other details. Both systems worked well, but the former was liable to be crippled by frost, and the appliances were very heavy and bulky. The author believed that in the future electricity would be regarded as the more advantageous agency. In many respects the author considered British practice to be in advance of the French.

Physical Society.—It is announced that the third annual exhibition of Electrical, Optical and other Physical Apparatus will be held at the Royal College of Science, South Kensington, on Friday evening, December 13th, from 7 to 10 o'clock.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station Officials.—From among the applicants for the position of electrical engineer at Haslingden, six have been selected to appear before the General Purposes Committee.

The staff of the Metropolitain Electric Supply Co., Ltd., met at the "Torino" Restaurant on Friday evening last, to give a "send off" to Mr. A. W. Wilson, who has been a member of the mains department for the past 18 years. Mr. Wilson is leaving the company to take up a position with the British Insulated and Helsby Cables Co., Ltd. Mr. E. Cunliffe Owen, C.M.G., the company's secretary, presided, and presented Mr. Wilson with a gold cigarette case.

The appointment of Mr. A. Blanes, as canvasser and consumers' adviser to the St. Pancras electricity undertaking, is to be continued for a further period of two years at a salary of £170 per annum, together with a commission of 1s. for every thousand units sold to private consumers beyond the number sold the previous year, and an allowance of 10s. per week for expenses.

General.—In connection with the Harmsworth Self-Educator, recently completed, an examination was held bearing upon the subjects dealt with therein, and the first place in "Electricity" was taken by Mr. Samuel Frith, the promoter of the New Liverpool and District Electrical Association. For this success he is entitled to a ticket for a tour to Greece, Egypt and Palestine, &c.

Mr. R. J. Nobbs, of the electrical staff of the Dynamic Syndicate, Ltd., Mitcham, was presented with a Bank of England note on the occasion of his marriage, by Mr. Howard Lacy, on behalf of the staff.

Mr. H. W. Ingram has been elected chairman and Mr. A. J. Thomas deputy chairman of the St. Pancras Electricity Committee for the ensuing year.

The Huddersfield T.C. has appointed Mr. L. Southerns, of Blackburn, as assistant lecturer and demonstrator in electrical engineering at the Technical College.

Mr. Alderman Trumble, J.P., and Mr. Councillor J. Anthony Trythall, have been re-elected chairman and vice-chairman respectively of the Croydon Corporation Tramways Committee for the ensuing year.

Mr. W. B. Trentham, consulting engineer, informs us that he has taken into partnership Mr. A. E. Heming, recently constructional engineer to Marconi's Wireless Telegraph Co., Ltd. The title and address of the firm will be "Trentham & Heming," 39, Victoria Street, Westminster.

On Friday evening last the shop staff of the switchgear and controller section of the British Westinghouse Co., Trafford Park, Manchester, entertained at dinner their superintendent, Mr. A. M. Randolph. Advantage was taken of the occasion to present him with an enlarged photograph of the staff, suitably engraved. Mr. Currie, general foreman of the section, made the presentation. We understand that this is the first presentation made to an official who has not been leaving the company's employ.

Mr. Dykes (of Messrs. Handcock & Dykes, of Westminster) has been elected a member of the Beckenham Council at a by-election.

The death has occurred of Mr. H. S. Distin, district manager at Exeter for the National Telephone Co., and formerly of Swansea. He was 37 years of age.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Ackroyd & Best, Ltd. (54,600).—This company's annual return was filed on September 21st, when 2,784 preference and 1,800 deferred shares had been taken up out of a nominal capital of £25,000 in £5 shares (3,200 preference and 1,800 deferred). £5 per share has been called up on 2,684 preference and £13,420 has been received. £9,500 is considered as paid on 100 preference and 1,800 deferred. Mortgages and charges: £20,300 sealed debentures, £1,350 applied for and paid for, but not yet sealed, and £3,500 floating debentures to cover overdraft at bank and guarantors.

Westinghouse Cooper-Hewitt Co., Ltd. (89,947). — This company's annual return was filed on October 17th, when the entire capital of £10,000 in £1 shares had been taken up, and 5s. per share had been called up. Mortgages and charges: Nil.

Westinghouse Metal Filament Lamp Co., Ltd. (89,948).—This company's annual return was filed on October 17th, when the entire capital of £10,000 in £1 shares had been taken up, £10,000 being considered as paid. Mortgages and charges: Nil.

CITY NOTES.

Cape Electric Tramways, Ltd.

The eleventh ordinary general meeting of the above company was held on Wednesday at the London Wall Buildings, E.C., Colonel Sir Charles Euan Smith, K.C.B., C.S.I., presiding.

The Chairman, in moving the adoption of the report, said that the commercial depression at Cape Town and Port Elizabeth, on which so much stress was laid last year as the predisposing cause for the reduction of their receipts, had shown no amelioration since then, and at the moment was still in full force. This, and the continued hostility of the Sea Point Municipality, had been responsible for the most serious diminution in their revenue. Although the Cape system actually carried nearly 190,000 more passengers than last year, the gross revenue resulting fell off by about £16,000. He was glad to be able to say that owing to the retrenchments which had been rendered possible by changed economical conditions, this shortage of revenue had been met by savings in working expenses. Last year he alluded to the circumstances which were operating so severely to their disadvantage, and it was necessary for him again to refer to the ruinous and senseless competition which was originally instituted by the Cape Government at the instigation of the Sea Point Municipality, and which

had been since carried on by the municipality regardless of, it seemed to him, any consideration either for common sense or for sound commercial principles. In March last the Railway Department of the Cape Government, acting under pressure from the Sea Point Municipality, made further reductions in the already reduced fares. This reduction lowered the fares chargeable on the Sea Point Railway between Cape Town and Sea Point to a figure actually below that upon which any railway whatever could be operated, and at the same time give profitable results even of the most modest character. In self-defence the board had to meet such suicidal reductions by following the same course. In consequence of this, and owing to the greatly superior position of the tramways, to the greater convenience to the residents of Sea Point and other suburbs en route afforded by the tramways, and the more convenient service, as against less adequate service on the railway, they now carried the bulk of the passengers, although at low rates. This made it evident that the high-handed expropriation of their property for the benefit of a small section of the public, carried out by the Cape Government, had signally failed in its object. They still carried the great bulk of the traffic between Cape Town and Sea Point, and their cars were crowded with passengers, while the railway ran empty trains at a serious loss. But no one benefited even temporarily save the Sea Point ratepayers, who used the cars, and who were enjoying the advantage of extraordinarily cheap and unremunerative fares, against the increased taxation, which they would certainly have to bear hereafter when the Sea Point Municipality's accounts had to receive final adjustment. The result of the 18 months' persecution of the company had benefited no one, but it had immensely reduced their legitimate profits, in the rightful earning of which they had every reason to count on the support of the Cape Government. At the same time it had saddled the ratepayers of Sea Point with a burden of debt, which was due by them in an increasing ratio to the Cape Government Railways, and which, they were informed, had in the month of June last already reached a formidable figure. When the railway reopened in December, 1905, in that month the gross takings were £1,654, and in August last they had fallen to £390. No more eloquent fact could be placed before them as indicative of the serious nature of the policy which had been pursued against them. The directors had made every effort to induce the Government to exercise the authority which rested in their hands to bring the Sea Point people to reason. When the Prime Minister and Commissioner of Crown Lands and Public Works were over here, in the early part of the year, they interviewed them, and obtained their approval of a joint tariff which they were willing to agree to with the Sea Point Railway, and they promised to use their best endeavours to induce the Sea Point municipality to adopt the tariff. It was with regret he had to report that at this date the position of affairs was in no way altered. When the Cape Parliament passed the Act empowering the Government to operate the Sea Point Railway on behalf of the municipality, and to accept the security of the Sea Point rates against loss and for the payment of 4 per cent. interest on capital expended, it was with the avowed object of relieving the supposed congestion of traffic on the tramline, and of affording the inhabitants of Sea Point an alternative line of communication with the capital. They were convinced that this Act was never intended to be used as it had been as a weapon in the hands of a prejudiced municipality, to institute a vindictive persecution against their tramways with the avowed object of accomplishing their ruin. That this was the real object was clearly demonstrated by the public utterances of certain of the municipal Councillors, who had not hesitated to publicly state their wishes and intentions in this respect. The Cape Electric Tramway Co. embarked its capital on the security of an Act of Parliament of the Cape of Good Hope granting it the tramway concessions, and had this not been regarded as a sign of friendliness and support on the part of the Government the requisite capital would not have been found. This fancied security had signally failed to protect them against a serious attack on their legitimate rights in South Africa which had been connived at by the Government. This action of the Cape Ministry, if not rectified, must ultimately tend to act as a deterrent against the future investment of capital in Cape Colony. Sooner or later, however, they felt, the voice of common sense and public interest must make itself heard, and then fares must regain their right level. In this belief they continued their operations. Their system was in first-rate order, and was administered with sound judgment and economy.

Mr. L. Breitmeyer seconded the motion.

Mr. Hayes pointed out that two years ago they were called upon to find a large sum of money for relaying the tramways, and they were told that the conditions of Cape Town were such that they would often have to be relaid. While they might be content to do without their dividend, they would like an assurance that they would not be called upon to provide more money.

Mr. W. B. Rommel (managing director) said their track at present was in first-class order, as well as the rolling stock, and they were making provision for the future. They were not, perhaps, putting so much by as they would if things had not been so depressed, but he did not think there was any fear of further capital being required for such contingencies.

The report was adopted.

The Eastern Telegraph Co., Ltd.

The seventy-first ordinary general meeting of the shareholders of this company was held on Wednesday, at Electra House, Finsbury Pavement, Sir John Wolfe Barry, K.C.B., in the chair.

In proposing the adoption of the report (see Electrical Review, November 8th, p. 781), the Chairman said that the accounts covered the first half of the new financial year, which now ended at December 31st instead of March 31st as heretofore. In the absence of an account for the corresponding period of 1906, it was somewhat misleading to attempt comparisons of income, as the present accounts included the most productive quarter of the year, viz., the March quarter, which had hitherto been included in the final half of their financial year. That circumstance accounted for their being able, at the interim half-year, to make a further contribution of £120,000 to the general reserve fund and to carry forward a substantial balance of over £41,000, whereas at the interim half-year in 1906, ending on September 30th, no contribution was made to the general reserve fund, the entire balance of £117,000 being carried forward and dealt with in the accounts for the three months ending December 31st, 1906. In view of the above they must not expect such a large balance for the current half-year ending December 31st, 1907. He had again to record a considerable falling-off in their receipts from traffic with South Africa, the decrease applying alike to ordinary, Government and Press messages. He had occasion to refer at previous meetings to this branch of their traffic, which had shown a persistent reduction for some time, and although it might be dangerous to prophesy, he must say that he could see no important indication of any great improvement in this direction in the near future. On the other hand, he was pleased to record a continued increase in their receipts from messages exchanged with India, Egypt and South America; other branches of their traffic showed but slight variations when compared with the corresponding half-year. Owing to the alteration in the dates of making up their accounts, he thought it would also be more satisfactory to defer any detailed comparison with regard to the expenditure side of the revenue account, but he was glad to say that the *total* expenses were considerably less on balance than they were for the half-year ended September 30th, 1906, this being due to the fact that their repairing steamers had been exceptionally busy on work for foreign Governments and other companies, thereby reducing the charge in respect of maintenance of cables. During the half-year their c.s. *Britannia* had been specially overhauled, and to meet this expenditure the sum of £5,000 had been taken from the maintenance ships' fund in accordance with their usual custom. He would now refer to an item in the balance-sheet which the board had considered advisable to deal with on the present occasion—he alluded to the investments in respect of reserve funds. As they were all aware, these investments had always appeared in their accounts at cost price, and full details had invariably been shown, so that anyone could see the amount of appreciation or depreciation each half-year by comparing the cost with the prices ruling. Although the market value had at times been in excess of cost, and at other times below cost, it had never been their custom to make any corresponding adjustment of the figures appearing in the balance-sheet, and this action appeared to have been approved by the general body of stockholders in the past. It had always been the practice of the board to invest the reserve funds in securities of the highest class, with a view of their being available from time to time when they might have to provide for expenditure out of the reserve funds. In consequence of the continued extraordinary fall in the market value of the stocks which they held in common with that of all other gilt-edged securities, they thought that the time had come to make some provision in the accounts for fluctuations in the market value of their investments. They had carefully considered the matter in all its bearings, and were also anxious that there should be no possibility of a misunderstanding on the part of any individual stockholder who might not be able to appreciate the question so readily as if some specific entry were made in the accounts, and might think that large as was the amount of their available resources, they were, in fact, more than in effect could be realised. Although there was every hope that at some future date the investments would improve in value, it might be questionable if they would again reach the high prices at which they were obliged to purchase them some years ago. As stated in the report, the sum of £130,000 had accordingly been taken from the general reserve fund and deducted from the figure appearing in the balance-sheet as representing the cost of the investments they held. Having referred to the question of depreciation of investments, he thought it was an opportune time again to draw attention to the great importance of reserve funds generally in connection with submarine cable enterprise. He thought they might all congratulate themselves that their reserves now amounted to a total of £1,698,000. He had been looking through some of the earlier records of the proceedings of their general meetings, and he found that it took some time, and not a little persuasion on the part of the directors, to convince the general body of stockholders that it was a wise policy to accumulate large reserves. This policy was initiated by their first chairman, the late Sir John Pender, and had always been unanimously and consistently supported by the board. He thought it had been proved, and generally if not universally accepted, that the success of this company was in a large measure attributable to the creation and building-up of substantial reserves. He found that since the incorporation of the company, no less a sum than £4,386,000 had at one time and another been applied out of the general reserve fund towards the cost of cables, renewals, &c. This had enabled them to improve the carrying capacity of their system; and by extending their service generally they had been enabled to reply to actual competition, and to face with equanimity any threatened competition to which a successful undertaking such as theirs was always liable. Besides, it enabled them to keep their capital account and standing charges within reasonable limits, so that, while paying a substantial and stable dividend to the ordinary stockholders, they had, at the same time, been able to consider the interests of their customers by making important reductions in the tariffs from time to time.

They would readily see, therefore, that the principle of maintaining substantial reserves rendered the stability of the company more secure, besides ensuring the real value of their holding in the company, notwithstanding the present fall in the market price of their securities, which was the case with many other companies, and, in their opinion, was only of a temporary nature. With regard to the question of wireless telegraphy, they would no doubt have read the extract from his remarks on this subject which he made at the general meeting of the Western Telegraph Co. the other day, and as he had nothing further to say in connection with this matter, it would be a work of supererogation to take up their time by discussing the subject further.

Sir JOHN DENISON-PENDER, K.C.M.G., seconded the motion.

MR. NEWBY asked how far those interested in wireless telegraphy claimed that they could transmit messages.

MR. NEWTON said he was sorry that the board had written down the investments so ruthlessly. His view was that the present depression in gilt-edged securities would soon pass away, and prices would again revert to their normal level.

The CHAIRMAN, in reply, said he did not think that anybody who understood the subject had set a bound to the distance that the waves could travel through the ether. It depended entirely upon the amount of energy put in the creation of the waves, and the distance it was required to travel. The point was as to what would happen when they tried to read the messages 3,000 or 4,000 miles away, and at present they were very sceptical about the matter. As he had said at the meeting of the Western Telegraph Co., he did not believe that cable companies would find wireless telegraphy a serious competitor. With regard to depreciating their reserves, it was, after all, only a book entry—they remained exactly as they were before, but they made the depreciation in case of a possible loss when they were obliged to realise any of their securities for the sake of cable enterprise.

The report was then adopted.

Amazon Telegraph Co., Ltd.

THE annual meeting of this company was held on Tuesday, at 42, Old Broad Street, E.C. Mr. George Keith presided, and moved the adoption of the report for the year ended June 30th, 1907, which showed that the traffic receipts amounted to £66,204 as compared with £63,849 for the previous year, an increase of £2,355. The gross revenue was £83,815 and the total working expenses £48,073, to which was added £27,014 for debenture interest and sinking funds, leaving a balance to the credit of the revenue account of £8,728 for the year, thereby reducing the debit balance to £65,878 as compared with £74,607 of the previous year.

The CHAIRMAN said that the accounts showed considerable improvement in the business. There was an increase in revenue and a decrease of expenditure which, as far as it went, was satisfactory. The improvement was the result of the better state of the rubber trade on the Amazon. The rubber exports had been largely in excess of those of the previous year, when a large portion of the rubber was held up by the waters falling earlier than usual, which delayed it in coming down the river until the following season. That made a large reduction in the rubber receipts in that year, and a corresponding increase in those of the year under review. The traffic transmitted over their cables was affected in the same way, which showed how intimately connected the company's business was with the rubber trade. The receipts had not, however, increased proportionately to the traffic owing to the loss due to the currency. The cables had worked well and earned their full subsidy. Expenses at stations were less, also the cost attending the maintenance of the cables, which included the miscellaneous expenses incurred in carrying out some special surveys. The number of repairs required by the cables had also been less, and there was a satisfactory decrease in message quarterage for keeping up the cable when the cables were down and under repair. Unfortunately part of the cable became interrupted and could not be recovered, and some 20 miles had to be abandoned and relaid, which had increased the amount of cable used for repairs during the year. The debenture charges for interest and redemption remained unchanged, and after providing for that as well as the working expenses, there was a surplus of £8,728 going to reduce revenue deficit. As regarded the present year, as far as it had gone, the traffic receipts were considerably increased, but much depended upon the rubber crop which had just commenced to come down the river. The Conversion Bill to which he referred last year fixing the value of the milreis at 1s. 3d. had become law, and so far had been very successfully carried out to the great advantage both of the company and of producers for export in Brazil. A great improvement in the economic situation of the Amazonas was expected, and the Governor had dealt with the matter very fully in his message to Congress last July. If this improvement were realised he (the chairman) hoped to see the position of the company greatly improved.

The report was adopted, and Mr. C. W. Parish was re-elected a director.

The West India and Panama Telegraph Co., Ltd.

THE sixty-first ordinary general meeting of the members of this company was held on Wednesday, November 13th, at Winchester House, Old Broad Street, Mr. W. B. Kingsford presiding.

The CHAIRMAN, in moving the adoption of the report (see ELECTRICAL REVIEW, November 8th, p. 781), said that since they last met, the history of the half-year under report had been uneventful, and therefore there was very little for him to comment upon. To paraphrase a well-known saying, he might say "happy was the company that had no history." As shown by the accounts, the receipts were £43,832, against £36,999 for the corresponding period of 1906, being an increase of £6,833. Having regard to the field in which they carried on their operations, he thought they might regard the result as not unsatisfactory. The increase was principally due to rather more commercial activity in some of their foreign stations. The expenses were £4,348 more than for the corresponding period. That was attributable to their having re-established telegraphic communication between St. Lucia and Dominica, which they would remember was interrupted by the eruption of Mount Pelee, in Martinique, in 1902. The directors felt that the time had come when the operation of connecting Dominica with St. Lucia direct might safely be undertaken, thus restoring its former duplication to that part of their system. The result of the half-year's working was a profit of £13,804, to which had to be added the balance brought forward and interest on investments, making a disposable total of £16,052. They would recollect that last half-year they were able to clear off the balance of arrears of dividend on the first preference shares, and now they were able to recommend the payment, not only of the full six months' dividend on the first preference shares, but also £1 per share on account of accrued dividends on the second preference shares. The directors felt much satisfaction in being able to make that recommendation. They would be glad to know that the traffic receipts were being fully maintained, those at the end of October being slightly in excess of those for the corresponding period of last year, and also that all their cables were in good working order. They trusted that they would remain so, more especially as the hurricane season in the West Indies was now over.

MR. HENRY HOLMES seconded the motion.

MR. BIRKS congratulated the directors upon the satisfactory report. It was, he said, very gratifying to them to know that the past half-year had turned out so well; that the current traffics were good; that the prospects of the future traffics were favourable, and that the whole of their cables were in good working condition.

The report was then adopted.

British Columbia Electric Railway Co.

THE eleventh ordinary general meeting was held on Thursday, November 14th, at the Great Eastern Railway Hotel, under the chairmanship of Mr. R. M. Horne-Payne.

In moving the adoption of the report (see ELECTRICAL REVIEW, November 8th, p. 780), the CHAIRMAN said they could congratulate themselves particularly on two points, viz., that they were able to recommend an increased dividend, which placed the deferred stock on an 8 per cent. basis and the preferred stock on a 6 per cent. basis; and that at a moment of unparalleled financial stringency, when money was being sought on almost any terms, however extravagant, by the foresight of the directors the company was able to show cash and other liquid assets to the extent of over £1s0,000. In view of what had occurred during the past year in Great Britain, and to a less extent in Eastern Canada and the Eastern United States, they might look upon the fetish of municipal ownership as being quite dead, and he thought the ratepayers all over the world clearly understood that municipal ownership almost invariably meant extravagance and corruption, and unbearable rates for the rest of the population. From time to time during the past few years one had heard outcries against the Montreal Electric for paying 10 per cent. on their shares at the expense of the public, and similarly against the Ottawa, Toronto, Winnipeg and all other successful companies, and now no doubt the same cry would be raised against them. Those who did so did not recognise that it was on a very small portion of the capital that the higher dividend was paid. In their case it was on less than four-fifths of the total money raised and expended in the enterprise. From an analysis of their results, he found that, from 1898 to 1902 inclusive, they returned less than 4½ per cent. on the money actually put into the enterprise. In 1903 the investment yielded 4·8 per cent.; in 1904, 5·1 per cent.; in 1905, 5·2 per cent.; in 1906, 5·1 per cent., and this year the returns on the actual cash invested was 5·564 per cent. It must be apparent to the most ordinary intelligence that an enterprise could be run by a board of directors, who were enabled to carry out a continuous policy from year to year and from decade to decade, more economically, and far more advantageously to the public they served, than by a body of men who were constantly changing from year to year. The former were able to plan out extensions—always provided they were not handicapped by short franchises—for years in such a way as to best meet the requirements of a growing city, and to exert and nurse its industries and its best interests. The board of the British Columbia Electric Railway had already adopted, in a general way, a comprehensive scheme spread over the next three years. On the other hand, they had again and again witnessed successive corporations incline to rival scientific systems which had involved the pulling up and destruction of the costly installations put in by their predecessors. Another point at which municipalities were at a great disadvantage, was that of finance, for however good a man might be, unless he was brought up to finance in one of the great money centres of the world, he was at a loss when money had to be raised. He could conceive no more pitiable plight than for such persons to be suddenly called up to raise several hundreds of thousands of pounds to meet the needs of the ever-growing cities like those they served. He believed that the days of cheap money for municipalities were gone, once and for all, and that in the near future the embarrassments of

municipalities would prove a serious menace to finance, and that large sums of money would be lost in municipal securities during the next ten years. Reverting to his remark as to the large amount of cash which the company had on deposit, he would point out that whilst money had been scarce in Canada, as in other places, no serious crisis had arisen, and the troubles of her great neighbour had been reflected only by the temporary difficulties of a few men who had been speculating in New York. He was glad to say that the prospects in Canada in general, and in British Columbia in particular, had never been brighter. In British Columbia the tide of progress had not been checked, and he saw nothing but success and prosperity before the country.

Mr. T. Blundell Brown seconded the motion, and the report was adopted.

Victoria Falls Power Co.

At the conclusion of the business at the extraordinary meeting held last week for altering the articles, Mr. H. Wilson Fox, who had recently spent a few days at the Victoria Falls, in company with Mr. Mershon and Mr. Arthur Wright, gave some account of the impressions formed during l' s visit. Powerful mining groups, with whom previously they had n t been successful in negotiating contracts, were now daily approaching them and asking them when they would be ready to supply them with power, and he had not the slightest doubt that as fast as they could put up their plant, that plant would be fully occupied with orders. They had more work offered to-day than they could cope with from their existing stations. They had two stations, which had an output of slightly over 6,000 kw. They were running day and night as hard as they could go, and they were having to turn away customers because they had not the power to give them. That was a very satisfactory position; for instead of having a long intervening period during the construction of their big plant, when everything would be going out and nothing coming in, they were to-day making profits at the rate of upwards of £80,000 a year. He was, of course, talking of working profits in South Africa. Their accounts not having been audited, he was not alluding to expenses in London, and so on; but this working profit in South Africa was at the rate of upwards of £80,000 a year, and the only deduction that would have to be made from that would be an allowance for depreciation of plant. As soon as the large plant was at work they would hope very greatly to exceed those profits. They had established very friendly relations with the Government of the Transvaal. He personally saw General Botha, Mr. Smuts, Mr. Hull, Mr. De Villiers, and other members of the Government, and one and all assured him that they would do their best to help them in every way; and those assurances had been acted upon. The Government realised that the establishment of these power facilities would be of great advantage to the Rand—that it would help them in the labour question and would give work to the unemployed, which for some time past had been a very difficult problem in the Transvaal. A further point had been that their electrical engineers had the opportunity of meeting personally and exchanging views with all the leading mining engineers and mechanical engineers on the Rand. The result was that they had been able to get to the bottom of each other's minds, and to find out what was wanted. They would hope, therefore, in laying out their installation, to be able to provide customers with exactly what they wanted. In regard to the Falls, although he could not make any definite pronouncement on the subject then, he might tell them that he had very good hope that within a comparatively short time they would have quite considerable demands for power for industries to be established close to the Falls. If so, that would be turning to account at an earlier period than they could have hoped another important asset. The two great assets to-day were the facts that they were the only large power suppliers on the Rand, and had therefore the command of the market, and that at the Falls they controlled one of the greatest natural producers of force in the world. If they could push these two sides of this work simultaneously their position would be very good.

Metropolitan District Railway Co.

The directors of this company have this week submitted to the proprietors of the various stocks a statement regarding the financial position of the company, and the steps which it is proposed to take in order to provide funds to meet requirements. The circular reads:—

"The completion of works in progress—including works connected with the electrification of the railway, the laying of two additional tracks between Hammersmith and West Kensington (for the use of which by the Great Northern, Piccadilly and Brompton Railway Co., the company receive a rental of £12,000 per annum), the reconstruction and improvement of stations which required renewal—and also the drainage and reballasting of the railway (which is now practically completed) have involved the expenditure of £241,064 since January 1st, 1906. In addition to this expenditure on works, it has been necessary to provide for deficits on revenue account for the four half-years ending June 30th, 1907, which, as appears from the published half-yearly accounts, have amounted in the aggregate to £152,023. It has been impossible to raise any moneys by the issue of additional capital since 1905, and the requisite funds have been provided by temporary loans on the security of the company's surplus lands. These temporary loans now amount to £385,000. The company are, however, unable to borrow any more money on the security of their surplus lands, and they have no further available assets except the Consols mentioned below.

"The surplus lands belonging to the company now yield a rental of £26,000 per annum. If these lands were sold by the mortgagees they would probably not realise a price at which it would be in the best interests of the company to sell them. The directors therefore consider that the company should continue to hold these properties, selling, from time to time, as advantageous sales can be effected.

"It is estimated that the deficit on revenue account, after payment of fixed charges during the current half-year, will amount to £35,000. But the greatly improved service on the railway and the increasing traffic will shortly bring larger revenues, and it is confidently expected that after 1909 the net revenue will be sufficient to pay all fixed charges.

"Arrangements are in progress for raising the moneys required to pay the expected deficit for the current half-year, so that the proprietors of the debenture stocks may receive their interest in full. The security to be given for the advance to meet this deficit will be a contingent sale of the sum of £50,938 Consols, constituting Parliamentary deposits in respect of the Deep Level Railway authorised in 1897, and in respect of other authorised works which are not now to be constructed. It is proposed to seek powers in the ensuing session of Parliament to abandon the construction of the Deep Level Railway, and to obtain a release of the deposits above mentioned."

The present requirements of the company are:—

1. To provide for repayment of the temporary loans ..	£385,000
2. To provide for estimated deficits on revenue account after the current half-year	45,000
3. To pay for works in progress and for necessary works of renewal and improvement during the next three years, including estimated expenditure on real property belonging to the company, in order to create additional rentals estimated at £12,000 per annum ..	145,000
4. For working capital	50,000
5. Contingencies	50,000
Total requirements	£675,000

The directors consider that "the best course to adopt is to seek the authority of Parliament to issue £750,000 prior lien redeemable debenture stock, ranking next after the rent charge stocks of the company, for the purpose of raising the funds for the above requirements. £550,000 of the proposed stock will be issued as soon as the requisite Parliamentary powers are obtained, and the balance of £200,000 will be issued if and when required. The proposed issue of £550,000 of the new stock, if issued, as it is expected that it will be, bearing interest at 4 per cent. per annum, will involve an interest charge of £22,000 per annum, but, as against this, there will be a saving of about £20,000 per annum, which is now payable for interest on temporary loans. The surplus land rental of £26,000 per annum, together with the additional rentals, estimated at £12,000 per annum, which it is proposed to create by the reconstruction of some of the stations and by building on surplus lands connected therewith, will thus be preserved for the company. The surplus lands are not now charged with the debenture debt of the company, but it is proposed to insert provisions in the intended Bill to extend the charge of the debenture-holders, so that it shall comprise these lands."

Notice is to be given for a Bill in Parliament to carry out the above scheme.

Richard Hornsby & Sons, Ltd.—The directors recommend dividends for the year ended September 30th at the rate of 6¼ per cent. per annum; £10,000 is placed to reserve.

Kuala Lumpur Rubber Co., Ltd.—The report to June 30th, 1907, states that the output of rubber has been larger than was anticipated. The prices obtained have been satisfactory, as the 31,902 lb. sold up to June 30th realised an average of 5s. 2⅝d. per pound. The profit for the 15 months is £7,612. In view of additional capital expenditure, the directors are of opinion that the cash resources of the company should be husbanded for the present, and they accordingly recommend a distribution of not more than 3 per cent., free of income-tax. This will absorb £5,400, leaving £2,103 to be carried forward. The visiting agent estimates that on both estates there will be about 37,700 rubber trees tappable during the coming year, from which he expects a yield of 74,400 lb.

Germany.—The Electrische Licht und Kraftanlagen-Gesellschaft, of Berlin, reports a profit of £85,580 for the last financial year as compared with £85,271 in the preceding twelve months. A dividend of 7 per cent. has been declared.

Delagoa Bay Tramways.—In the report of the Delagoa Bay Development Corporation for the year ended June 30th, it is stated that the net result of working the tramways has for the first time shown a small profit for the year, but no depreciation of plant has been provided for in the accounts.

Stock Exchange Notice.—The Committee has ordered the undermentioned security to be quoted in the Official List:—Shawinigan Water and Power Co.—$6,500,000 capital stock in shares of $100 each.

Dorman Long & Co., Ltd.—In their annual report, which shows a profit of £224,192, it is stated that additional furnaces for the production of steel ingots are in course of erection, and to meet the requirements of shipbuilders for small sections and the growing demand for bars, a new electrically-driven mill is to be put down. Every department is fully occupied, and prospects for the coming year are good.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Fortnight ended.	Receipts for the fortnight. £	Receipts for the fortnight. £*	No. of wks.	Total to date. £	Total to date. £*	Route miles open.	Inc.
Aberdeen	Nov. 13	1,301	— 112	24	35,685	— 1,534	14·4	..
Ayr	,, 16	364	+ 15	27	9,631	— 178	8	..
Bath	,, 13	1,370	— 4	46	36,748	— 1,601	18	..
Belfast	,, 15	7,245	+ 566	33	122,332	+ 8,315	36	..
Birkenhead	,, 17	2,037	+ 90	32	35,491	— 176	18·52	..
†Birmingham Corp.	,, 9	6,302	..	32	196,210	..	56·46	..
Blackburn	,, 13	2,152	+ 249	33½	37,994	+ 2,467	14·13	..
Blackpool Corp.	,, 14	746	+ 72	..	45,657	— 1,334	11·87	..
,, — Fleetw'd.	,, 16	508	+ 89	19	21,848	— 1,015	8·25	..
Bolton	,, 17	4,579	+ 448	33	76,359	+ 4,749	26	..
Bournemouth	,, 13	2,707	+ 183	32½	59,471	+ 1,071	21·5	2½
Bradford	,, 16	8,961	+ 588	33	156,053	+ 3,162	54	1
Brighton	,, 17	1,491	— 13	33	32,188	+ 2,906	9·5	..
Bristol	,, 15	9,597	+ 421	..	..	..	28·5	..
Brit. Elec. Trac. Co.								
Airdrie	,, 8	473	+ 32	44	9,976	+ 2	3·65	..
Barnsley	,, 8	335	+ 35	,,	7,466	+ 146	..	..
Barrow	,, 8	454	— 9	,,	11,558	— 241	5·37	..
Cavehill	,, 8	134	+ 29	,,	3,844	— 264	..	..
Devonport	,, 8	864	+ 7	,,	20,538	— 257	8·85	..
Gateshead	,, 8	2,036	+ 41	,,	44,864	+ 1,156	11·25	..
Gravesend	,, 8	451	+ 14	,,	11,023	— 17	6·5	..
Greenock	,, 8	1,197	+ 164	,,	29,495	— 592	7·25	..
Hartlepool	,, 8	529	+ 13	,,	13,059	— 620	6·72	..
Kidderminster	,, 8	195	+ 14	,,	5,409	— 102	..	..
Leamington	,, 8	294	+ 25	,,	7,329	— 624	3	..
Merthyr	,, 8	438	+ 34	,,	9,407	+ 472	2·9	..
Metropolitan	,, 8	7,301	+3,151	,,	208,562	+53,481	22	..
Middleton	,, 8	656	+ 70	,,	15,883	— 100	5·5	..
Mid. Joint Com'tee	,, 8	11,876	+ 383	,,	269,692	+ 3,994	..	..
Oldham—Ashton	,, 8	1,196	+ 68	,,	20,760	+ 1,254	9·18	..
Peterborough	,, 8	230	+ 22	,,	5,770	— 175	5·81	..
Potteries	,, 8	4 067	+ 208	,,	83,860	+ 2,427	29	..
Rothesay	,, 8	90	+ 45	,,	10,121	— 566	2·75	..
Southport	,, 8	443	— 7	,,	13,556	— 658	3·17	..
S. Metropolitan	,, 8	1,510	..	,,	36,055	..	..	..
Swansea	,, 8	1,763	+ 141	,,	41,239	+ 3,051	5·5	..
Tynemouth	,, 8	307	+ 13	,,	11,108	— 763	3·75	..
Weston-s-Mare	,, 6	79	— 2	,,	6,914	— 381	3	..
‡Worcester	,, 8	320	+ 23	,,	12,797	— 175	5·75	..
Wrexham	,, 8	198	+ 1	,,	4,607	— 82	..	..
Yorks. Wool. Dist.	,, 8	1,799	+ 76	,,	41,741	+ 876	17	..
Miscellaneous	,, 8	420	+ 6	,,	10,049	— 185	..	..
Burnley	,, 17	2,453	+ 241	..	..	..	7·5	..
Burton-on-Trent	,, 17	499	— 48	33	9,706	— 467	11	1·5
Bury	,, 10	2,178	..	32	36,400	..	10·5	..
Cardiff	,, 9	4,014	+ 139	32	70,517	+ 1,925	15·87	..
Carlisle	,, 16	351	+ 9	46	8,091	— 534	..	..
Chatham and Dist.	,, 14	1,330	+ 34	46	33,203	+ 1,316	12·16	·68
Cork	,, 14	820	+ 25	46	21,743	— 805	9·89	..
Croydon	,, 15	2,207	+ 75	33	47,968	— 1,949	12	·75
Darlington	,, 16	424	+ 11	33	7,095	— 40	..	..
Darwen	,, 15	489	— 2	33	8,552	— 17	4·36	..
†Dover	,, 9	182	— 19	32	7,870	— 1,041	4·75	..
Dublin	,, 15	10,885	+1,716	..	138,539	+30,842	54·25	5·5
Dundee	,, 13	2, 45	+ 100	26	80,203	+ 830	13	..
East Ham	,, 16	1,683	+ 97	33	30,585	— 105	7·75	..
Exeter	,, 15	504	— 12	33	18,001	+ 622	4·75	·5
Glasgow	,, 16	31,794	+2,027	24	423,152	+12,605	89·75	5·5
Hastings	,, 14	1.729	..	..	..	..	..	..
Huddersfield	,, 16	3,064	+ 253	33	53,538	+ 2,635	28	..
Hull	,, 16	4,981	+ 305	33	81,389	+ 4,246	13	..
Ilkeston	,, 13	267	+ 25	33	4,852	+ 274	3·5	..
Ipswich	,, 16	687	— 72	33	14,037	— 1,078	10·5	..
Isle of Thanet	,, 16	5·0	+ 78	46	30,705	— 293	11	..
Kilmarnock	,, 16	288	— 1	26	4,279	— 105	4·25	..
†Lan'kshire Trm Co.	,, 7	1 301	+ 476	45	54,078	+14,107	15·82	3·26
Lancashire United	,, 13	2,464	+ 386	46	58,597	+18,632	39	1
Leeds	,, 9	12,7 5	+ 840	32	212,875	+ 9,055	51·13	..
Leicester	,, 16	4.356	+ 99	..	..	..	..	..
†Leith	,, 9	500	+ 12	25½	13,906	+ 43	6	..
Liverpool	,, 9	21,947	+ 676	45	493,238	+ 8,105	104	..
‡L.C.C.	,, 9	63,963	+13,760	32	1,011,454	+169,592	116·5	10
London United	,, 15	11,407	+ 921	..	300,648	+13,058	..	..
Lowestoft	,, 16	348	+ 2	7	1,278	— 43	3·5	..
Manchester	,, 16	30,871	+1,969	33	495,616	+35,538	86	11
Newcastle	,, 16	8,137	+ 96	33	136,323	+ 683	..	..
†Newport	,, 9	632	+ 54	32	22,630	+ 1,764	14·5	..
Northampton	,, 15	762	+ 6	32½	14,638	— 495	5·5	..
Oldham	,, 17	3 803	+ 319	34	66,789	+ 4,311	23·75	..
Pontypridd	,, 16	541	+ 2·3	33	8,830	+ 3,277	6	1·75
Portsmouth	,, 16	3,308	+ 274	33	69,175	— 1,620	14·5	..
Preston	,, 13	1,126	+ 59	..	..	..	..	..
†Reading	,, 7	581	— 9	31½	20,150	— 738	13·25	..
Rotherham	,, 14	1,390	+ 278	32½	20,072	+ 3,301	10	·66
†Salford	,, 11	4,531	+ 208	32	151,952	+ 4,366	38·9	..
Sheffield	,, 17	11,226	+ 835	34	190.209	+ 9,138	35·75	..
Southampton	,, 13	1,930	+ 181	32	31,590	+ 1,618	..	..
Southend-on-Sea	,, 13	572	+ 27	33	14,692	— 60	..	..
Sunderland	,, 17	2,457	— 98	33	46,961	— 769	..	..
Swindon	,, 13	806	..	..	..	..	4·4	..
Tyneside	,, 13	822	+ 61	46	21 394	+ 916	8·67	..
Wallasey	,, 16	1,501	+ 66	33	28,687	+ 791	8·72	·22
Walthamstow	,, 16	188	+ 113	33	21,022	+ 442	9	..
West Ham	,, 14	4,358	+ 241	33	77,409	+ 1,451	14·7	..
Wolverhampton	,, 13	1,630	+ 18	32	31,287	+ 250	12·5	..
Yorks. W. Riding	,, 17	3 381	+ 209	46	58,790	..	..	..
Baker St.-Waterloo	,, 16	5,675	+1,455	20	48,380	+17,545	4·25	1
Cen. London Rly.	,, 16	12,208	—1,679	20	102,586	—15,954	6	..
Char. +, Eus. Hamp.	,, 16	5,800	..	20	49,030	..	7·75	..
City & S. Lon. Rly.	,, 17	6,575	+ 443	20	61.875	+ 8,738	7·3	1·05
Dublin-Lucan Rly.	,, 15	198	+ 10	20	2,846	+ 241	7	..
G.N. and City Rly.	,, 16	3,757	— 26	20	33,063	— 717	3·5	..
G.N., P'dy. & Brmp.	,, 16	9,880	..	20	77,990	..	9	..
L'pool Overh'd Rly.	,, 17	2,811	+ 56	20	31,738	+ 1,784	6·8	4·8
Mersey Railway	,, 16	3,729	+ 252	20	36 696	+ 2,584	4·5	..
†Metropolitan Rly.	,, 10	15,828	+ 53	19	284.193	+ 5,827	24·5	..
Met. District Rly.	,, 16	17,635	+ 810	20	152,442	— 331	24	..
Anglo-Argentine	,, 10	37,294	+3,383	46	769.994	+73,423	48	..
§Auckland	,, 8	10,674	+ 946	44½	114 568	+ 5,001	19·2	·56
§Brisbane	October	13,587	+1,816	..	..	..	..	..
§Brit. Columbia Rly.	Sept.	31,449	+7,997	13	91,088	+21,163	6·8	4·8
Calcutta	Nov. 16	6,388	+ 110	..	..	..	..	..
§Cape Electric T. Ld.	August	9,240	..	..	..	..	..	..
§Geneva	October	8,557	+ 426	..	..	..	..	..
§Kalgoorlie, W.A.	,,	3,963	..	48	39,925	..	20·5	..
Madras	Nov. 16	1,162	+ 155	46	24,128	+ 4,016	12·75	·5
§Lisbon	October	7,970	..	..	..	..	..	..
Perth (W.A.)	Nov. 15	2.978	+ 141	46	64,525	— 2.149	25·6	·4
†Buenos A. & Belgro.	,, 11	4,802	+ 269	45	178,425	+ 9,551	..	..

* Compared with the corresponding period of 1906. † One week only.
‡ Includes horse, steam and other receipts. § One month.

STOCKS AND SHARES.

Tuesday Evening.

After being strung up to an acute state of nervous apprehension, Stock Exchange markets suddenly recoiled from their severe depression on the news that the United States Government had come officially to the aid of the harrassed money market in America. The effect was instantaneous. Released from the fears that had pinned them down, prices bounded up in all the active markets, and instead of a rise to 8 per cent. in the Bank Rate, of which everyone spoke with certainty last Saturday, the betting veered round to a possible change in the very opposite direction occurring this week.

That all the crisis of the past three weeks is not to be righted in a day will go without saying. The best authorities look for "jumpy" markets up to the end of the year, but it is manifest that the worst of the trouble is over, and that with ordinary good fortune, prices should quietly recover on the whole.

Electricity issues, generally speaking, have not yet participated in the firmer feeling. Some of the Telegraph stocks rallied, but as no startling fall took place during what one may now call "the crisis," so nothing of a sensational nature has marked the rebound amongst electrical sections.

New companies which have been shelved of late will be thinking of an early appearance, and the week has seen several rubber propositions offered to the public. We hear of a scheme, rather nebulous at present, for floating a Rubber Trust Company upon somewhat ambitious lines. Of this, however, more will be heard in a little while.

Underground Electric Profit-sharing Notes are a further 2 points lower at 38. This, too, notwithstanding a sudden burst of strength in Home Railway stocks, which even brought about a 3 points rally in Central London Ordinary. It is long since an alteration in this more pleasant direction has had to be noted in "Twopenny Tube" stock. Metropolitan Consols advanced to 35½, but Districts fell to 11. It is stated that the "Circle" is shortly to be served by Metropolitan trains only, and that the District will concentrate all energies upon its other traffic. City and South London is slightly weaker.

Another recovery, after long falling, is that which put British Electric Traction shares a little better. The Preference have hardened ⅛, the Ordinary ¼, but the First Debenture stock fell a point. There is a good deal of interest taken in the question of the next dividend on the Preference shares. Some think the payment will not be more than 4 per cent. The money does not fall due, of course, until next February. Contradictory movements are also to be seen in the case of Anglo-Argentine Trams, where the First Preference are ⅛ down, while the Seconds are ¼ better. When financial matters get into normal grooves, the latter shares may be expected to come more into favour with the speculative investor.

The American group has naturally received most attention in the Telegraph section. Anglo-Americans have sprinted sharply, the Preferred stock putting on no less than 4 points, the other issues being good in proportion. Direct United States shares have not moved. Eastern Ordinary rose a point, and "China" shares added 10s. to their price, making it 12 middle. West Coast of America shares have been a little better, but Western Telegraphs came on offer, and so did West India and Panama shares, the Second Preference of the latter company more particularly after their recent rise. Marconi shares have been freely offered, the price falling as low as 13s.

Several of the shares in the Metropolitan lighting companies are lower on the week, although City of London Ordinary stand out with a rise, as bright exceptions. We are told that there is dissension in the councils of the companies, dissension upon the vital question as to what shape the projected Parliamentary Bill shall take next session. Two of the concerns are said to be standing out against the proposals, and unless unanimity can be secured, the London lighting industry in the hands of the companies will remain in as unsatisfactory a state as ever, or worse.

Cromptons rose to 1⅞, but came back again to 35s. Edison and Swan issues have been weak, and Willans & Robinson Debenture shed a point. British Aluminiums were lowered. Bruce Peebles Preference, it may be stated, are changing hands on the basis of 1½—1⅝, while there is a buyer at 95 of the debenture stock.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. *	Dividends for the last four years. 1903.	1904.	1905.	1906.	Closing Quotations Nov. 12th.	Closing Quotations Nov. 19th.	Business done week ended Nov. 19th, 1907. Highest	Lowest.	Rise + or Fall —	Present Yield per cent. £ s. d.
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	..	3 — 8⅜	3 — 8⅜	..	..	..	Nil
149,600	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	Nil	Nil	5 %	5 %	85 — 88	85 — 88	..	..	..	5 13 8
660,660	Anglo-American Telegraph	Stock	6½.	2⅜%	3¼%	3¼%	52 — 55	54 — 57	55	54	+2	6 16 0
3,169,670	Do. do. do. 6 % Pref.	Stock	6 %	5⅜%	6 %	6 %	92 — 95	95 — 98	97	94½	+3	6 2 5
3,169,670	Do. do. do. Deferred	Stock	2s.	Nil	⅛%	1⅜%	13⅜ — 14¼	13⅜ — 14½	14½	13¼	+ ⅜	12 5 8
50,000	Anglo-Portuguese Tel., 5 % Mort. Deb. Stock Red.	100	..	..	5 %	5 %	99 —102	99 —102	..	..	..	4 18 0
44,000	Chili Telephone, Nos. 1 to 44,000	5	7 %	8 %	8 %	8 %	6¾ — 7¼	6¾ — 7¼	..	..	..	5 10 4
2,097,680	Commercial Cable Stng. 500 year 4 % Deb. Stk. Red.	Stock	4 %	4 %	4 %	4 %	84 — 88	84 — 88	85⅛	84	..	4 10 11
16,000	Cuba Telegraph	10	0 %	5 %	5 %	5 %	6 — 7	6 — 7	..	..	..	7 2 10
6,000	Do. 10 % Pref.	10	15 %	10 %	10 %	10 %	15⅜ — 16¾	15 — 16 xd	..	..	— ¾	6 5 0
12,931	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	4 %	3½ — 3¾	3½ — 3¾	..	..	..	5 14 3
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	10 %	10 %	8½ — 8¾	8½ — 8¾	..	..	..	5 14 3
30,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	98 —101	98 —101	..	..	..	4 18 2
60,710	Direct United States Cable	20	3 %	3½%	4½%	4½%	12¼ — 13¼	12¼ — 13¼	12⅞	11½	..	6 19 7
57,000	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,200, R.	100	4½%	4½%	4½%	4½%	100 —102	100 —102	..	..	..	4 8 3
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	7 %	121 —126	122 —127	126½	122½	+1	5 10 3
2,000,000	Do. 3½ % Pref. Stock	100	3½%	3½%	3½%	3½%	80 — 83	80 — 83	80½	..	..	4 4 4
1,896,706	Do. 4 % Mort. Deb. Stock. Red.	Stock	4 %	4 %	4 %	4 %	99 —102	99 —102	..	..	..	3 18 5
300,000	Eastern Extension, Australasia, and China Tele.	10	7 %	7 %	7 %	7 %	11 — 12	11½ — 12½	12⅝	11⅜	+ ⅛	5 12 0
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	99 —102	99 —102	..	..	..	3 18 5
295,400	East & S. Afric. Tel., 4 % Mt. Db., 1 to 8,000, red. 1909	100	4 %	4 %	4 %	4 %	97½—100½	97½—100½	..	..	..	3 19 7
200,000	Do. 4 % Reg. M. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	98 —100	98 —100	..	..	..	4 0 0
181,127	Globe Telegraph and Trust	10	5⅛%	5⅜%	5⅛%	5⅛%	9 — 10	9 — 10	9⅛	9⅛	..	5 10 0
181,127	Do. do. 6 % Pref.	10	6 %	6 %	6 %	6 %	12 — 13	12 — 13	12⅝	12	..	4 12 4
150,000	Great Northern Telegraph, of Copenhagen	10	15 %	24 %	24%	20 %	29 — 32	30 — 33	31½	..	..	6 5 0
28,900	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	4½%	99 —101	99 —101	..	..	..	4 9 1
17,000	Indo-European Telegraph	25	10 %	13 %	13 %	13 %	50 — 60	52 — 55	..	..	..	6 5 0
$41,380,400	Mackay Companies Common	$100	..	1 %	2 %	3½%	50 — 60	50 — 60	..	..	..	5 16 8
$50,000,000	Do. do. 4% Cum. Pref.	$100	..	4 %	4 %	4 %	50 — 60	50 — 60	..	..	..	6 13 4
256,127	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	..	⅜— ⅝	⅜— ⅝	17/6	13/3	— 3/16	Nil
72,680	Monte Video Telephone Co., Ltd. Ord.	1	3 %	4 %	5 %	5 %	⅞— 1	⅞— 1	..	..	..	4 14 1
86,492	Do. do. do. 5 % Pref.	1	5 %	5 %	5 %	5 %	⅞— 1	⅞— 1	..	..	..	5 0 0
2,225,000	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	105¾—107½	106 —108	107½	105½	..	5 11 7
2,225,000	Do. do. Def. Stock	100	5 %	5 %	5 %	5 %	104 —106	104 —106	105½	104	..	4 14 4
15,000	Do. do. 6 % Cum. 1st. Pref.	10	6 %	6 %	6 %	6 %	10¾— 12¾	10¾— 12½	12	11⅛	..	4 16 0
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	5 %	10 — 12	10 — 12	11	..	..	4 8 4
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5⅜ — 5⅞	5½ — 5⅝	5⅝	5⅛	— 1/16	4 12 10
2,000,000	Do. do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	3½%	96 — 98	96 — 98	97½	..	..	3 11 10
1,689,593	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	100 —102	100 —102	101½	100	..	3 18 5
179,313	Oriental Telep. and Elec. 1 to 171,504, fully paid	1	6⅛%	6⅛%	7 %	7 %	1⅛— 1½	1⅛— 1½	..	..	..	5 12 0
50,000	Do. do. do. 6 % Cum. Pref.	1	6 %	6 %	6 %	6 %	1⅛— 1½	1⅛— 1½	..	..	..	4 16 0
100,000	Do. do. do. 4 % Red. Deb. Stock	100	..	..	4 %	4 %	90 — 93	90 — 93	91	90	..	4 6 0
100,000	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	10	4 %	4 %	4 %	4 %	97 —100	97 —100	..	..	..	4 0 0
11,889	Reuter's	8	5 %	5 %	5 %	5 %	7 — 8	7 — 8	..	..	..	5 0 0
60,000	Telephone Co. of Egypt, 4½ % Deb. Red.	100	..	..	4½%	4½%	98 —101	98 —101	..	..	..	4 9 1
3,167	Submarine Cables Trust	Cert.	6 %	6 %	6 %	6 %	124 —127 xd	124 —127	..	..	..	4 14 6
80,000	United River Plate Telephone	5	8 %	8 %	8 %	8 %	6¾— 7¼	6¾— 7¼	..	..	..	5 10 4
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 %	5 — 5½	5 — 5½	..	..	..	4 10 11
15,609	West African Telegraph, Shares	10	4 %	4½%	4 %	4 %	10 — 10½	10 — 10½	..	..	..	3 16 9
30,008	W. Coast of America, 1 to 30,000 & 53,001 to 53,008	2	Nil	Nil	Nil	2½%	1 — 1⅛	1⅛— 1⅜	..	..	+1/16	3 16 2
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	4 %	97 —100	97 —100	..	..	..	4 0 0
207,930	Western Telegraph, Ltd., Nos. 1 to 207,930	10	7 %	7 %	7 %	7 %	12½— 13½	12½— 13½	13	12½	— ½	5 5 8
800,000	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	99½—101½	98½—101½	..	..	..	3 18 10
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	Nil	1/16— 1/8	1/16— 1/8	..	..	..	Nil
34,563	Do. do. 6 % Cum. 1st Pref.	10	7 %†	6 %	5 %	8 %	7⅛— 8	7½— 7¾xd	7¼	..	— ¼	10 6 6
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	Nil	Nil	7½— 8¼	6½— 7½	..	..	— ¾	Nil
80,000	Do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	5 %	5 %	99 —102	99 —102	..	..	..	4 18 0

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

270,000	Anglo-Argentine Trams, 10 % Nom. Cum. 2nd Pref., 260,008 to 580,097	5	..	8 %	8 %	8 %	7 — 7½	7¼— 7¾	7⅞	7¼	+ ¼	5 3 3
260,007	Do. 6 % Cum. Prefs., 1 to 260,007	5	5⅛%	5⅛%	5⅛%	5⅛%	5½— 6	5½— 5¾	5¾	5¼	— ⅛	4 13 7
266,600	Do. Permanent, 6 % Deb. Stock, 1888	100	6 %	6 %	6 %	6 %	128 —131	128 —131	128½	..	..	4 11 7
285,100	Auckland E. Trams, 5 % 1st Mort. Deb. Stock	100	5 %	5 %	5 %	5 %	102 —105	102 —105	..	..	..	4 15 8
880,000	Babcock & Wilcox, 1 to 530,000	1	17 %	20 %	20 %	20 %	3⅝— 3⅞	3¼— 3½	75/-	73/9	— 3/32	5 6 8
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000	1	6 %	6 %	6 %	6 %	1⅛— 1⅛	1⅛— 1⅛	..	..	..	5 16 10
38,000	British Aluminium, Ord., 2,001 to 40,000	5	..	7 %	7 %	7 %	4 — 5	3½— 4½	78/9	77/6	— ½	7 7 4
40,000	Do. do. 7 % Cum. Pref.	5	Nil	7 %	7 %	7 %	4½— 5	4½— 5	95/-	..	— ⅛	7 0 0
20,000	Do. do. "A" 6 % Cum. Pref.	5	Nil	6 %	6 %	6 %	4¼— 5	4¼— 5	..	..	..	6 0 0
20,000	Do. do. 4 % Funding Certs.	5	..	4 %	4 %	4 %	3¾— 4½	3¾— 4½ xd	..	..	..	4 14 1
258,000	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	5 %	5 %	5 %	5 %	100 —103	100 —103	100½	100½	..	4 17 1
800,000	Do. do. 5½ % Loch Leven Debs.	100	..	..	..	5½%	96 — 99	96 — 99	..	..	..	5 11 1
400,060	British Columbia E. Rail Def. Ord. Stock	100	6 %	6 %	6 %	6 %	128 —133	128 —133	129	..	..	4 10 3
300,000	Do. 5 % Pref. Ord. Stock	100	5 %	5 %	5 %	5 %	112 —116	112 —116	112	..	..	4 6 2
300,000	Do. 5 % Cum. Perp. Pref. Stock	100	5 %	5 %	5 %	5 %	101 —105	101 —105	..	..	..	4 15 3
238,000	Do. 4½ % 1st Mort. Debs., 1 to 6,250	40	4½%	4½%	4½%	4½%	98 —101	98 —101	96½	94	..	4 9 1
220,000	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	4½%	4½%	4½%	4½%	102 —104	100 —103	..	..	—1½	4 7 5
133,301	British Electric Traction	10	6 %	6 %	3 %	Nil	1½— 1⅝	1½— 2	38/9	35/-	— ¼	Nil
161,437	Do. do. 6 % Cum. Pref.	10	6 %	6 %	6 %	6 %	4⅜— 5	4⅜— 5⅛	102/6	96/10½	+ 3	11 14 2
1,448,659	Do. do. 5 % Perp. Deb. Stock	Stock	5 %	5 %	5 %	5 %	94 — 97	93 — 96	95	93½	—1	5 4 2
410,178	Do. do. 4½ % 2nd Deb. Stock Red.	100	..	4½%	4½%	4½%	74 — 78	74 — 78 xd	75	74½	..	5 15 5
100,000	British Insulated and Helsby Cables	5	8 %	8 %	8 %	10 %	6¾— 7	6¾— 7	..	..	..	7 2 10
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	5⅝— 6⅛	5⅝— 6¼	..	..	..	4 18 0
500,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	4½%	4½%	4½%	4½%	101 —104	101 —104	..	..	..	4 6 7
212,000	British Thomson-Houston 4½ % 1st Mort. Debs.	100	4½%	4½%	4½%	4½%	85 — 89	85 — 89	..	..	..	4 18 11
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 475,000	5	6 %	Nil	Nil	Nil	⅝— 1½	⅝— 1½	..	..	..	Nil
1,016,353	Do. do. 4 % Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	55 — 65	55 — 65	..	..	..	6 3 1
50,000	‡Browett, Lindley & Co., Ord.	£1	Nil	Nil	Nil	..	0— 1½	0— 1½	..	..	..	Nil
50,000	‡ Do. do. 6 % Cum. Pref.	£1	Nil	Nil	Nil	..	14/6 to 15/6	14/6 to 15/6	..	..	..	Nil
105,731	Brush Electrical Engineering, Ord., 1 to 105,731	2	Nil	Nil	2½%	Nil	0— ½	0 — ½	..	..	..	Nil
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	6 %	6 %	Nil	⅜— ½	⅜— ½	..	..	..	Nil
125,000	Do. do. 4½ % Perp. Deb. Stock	Stock	4½%	4½%	4½%	4½%	83 — 86	83 — 86	..	..	..	5 4 8
125,000	Do. do. 4½ % Perp. 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	67 — 70	67 — 70	..	..	..	6 8 7
100,000	Buenos Ayres & Belgrano, 1 to 100,000	5	3 %	4 %	3 %	3 %	4⅜— 4⅝	4⅜— 4⅝	..	..	..	3 4 10
40,000	Do. do. "A" 6 % Cum. Pref., 1 to 40,000	5	6 %	6 %	6 %	6 %	4⅜— 5⅛	4⅜— 5⅛	98/1½	..	..	5 14 3
27,500	Do. do. "B" do., 1 to 27,500	5	6 %	6 %	6 %	6 %	4⅜— 5⅛	4⅜— 5⅛	..	..	..	5 14 3
13,200	Do. do. 5 % Deb. Stock	100	5 %	5 %	5 %	5 %	105 —115	105 —115	..	..	..	4 6 11
190,000	Do. do. 5 % 2nd Deb. Stock	100	5 %	5 %	5 %	5 %	102 —105	102 —105	..	..	..	4 15 3
187,610	Calcutta Trams, 1 to 187,610	5	6 %	8 %	8 %	8 %	6⅝— 7⅛	6⅝— 7⅛	..	..	..	5 12 3
30,000	Do. 5 % Cum. Pref., Nos. 1 to 29,880	5	..	..	5 %	5 %	5 — 5¼	5 — 5¼	..	..	..	4 10 11
350,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	100 —104	100 —104	..	..	..	4 6 7
85,000	Callender's Cable Construction shares	5	12½%	12½%	15 %	15 %	9½— 10½	9½— 10½	..	..	..	7 6 4
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	5½— 5⅞	5½— 5⅞	..	..	..	4 6 11
300,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	105½—107½	105½—107½	..	..	..	4 3 4
491,222	Cape E Trams., 1 to 491,222	1	10 %	5 %	Nil	Nil	⅜— ⅝	⅜— ⅝	..	..	..	Nil
450,000	Castner-Kellner Alkali, 1 to 450,000	1	4 %	4 %	6 %	8 %	1⅛— 1⅛	1⅛— 1⅛	27/6	27/-	..	5 11 4
224,988	Do. do. 4½ % 1st Mort. Deb. Stock	100	4½%	4½%	4½%	4½%	98 —102	98 —102	100½	100	..	4 8 3
911,568	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	4 %	54 — 57	57 — 60	59	56½	+ 3	6 13 4
544,216	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	4 %	83 — 85	83 — 85	..	..	..	4 14 2
544,216	Do. do. Def. do.	Stock	4 %	4 %	4 %	4 %	40 — 43	40 — 43	..	..	..	9 6 0
1,480,000	City and South London Railway	Stock	2⅜%	2⅜%	1¾%	2⅜%	44 — 46	43 — 45	44	..	..	4 14 5

* Unless otherwise stated, all shares are fully paid. † A period of nine months. ‡ From Manchester Share List.

(Continued on next page.

SHARE LIST OF ELECTRICAL COMPANIES.—(*Continued.*)

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—(*Continued*)

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years.				Closing Quotations Nov. 12th.	Closing Quotations Nov. 19th.	Business done week ended Nov. 19th, 1907.		Rise + or Fall —	Present Yield per cent.
		*	1903.	1904.	1905.	1906.			Highest	Lowest.		£ s. d.
85,000	Crompton & Co., Nos. 1 to 85,000	3	2½%	2½%	2½%	5 %	1 11/16 — 1 15/16	1⅝ — 1⅞	..	..	— 1/16	7 16 10
100,000	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	..	5 %	5 %	5 %	5 %	96 — 99	96 — 99	..	..	..	5 1 0
260,000	Dick, Kerr & Co., 1 to 260,000	1	..	10 %	10 %	10 %	1½ — 1⅝	1½ — 1⅝	..	..	..	6 13 4
305,000	Do. do. 6 % Cum. Pref., 1 to 305,000	1	6 %	6 %	6 %	6 %	1 — 1⅛	1 — 1⅛	22/6	..	..	4 16 0
294,150	Do. do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	101 —104	101 —104	..	..	..	4 6 7
60,000	Dublin United Trams. (1896), 1 to 60,000	10	5½%	6 %	6%	6 %	13 — 14	12½ — 13½	..	..	— ½	4 8 11
59,987	Do. 6 % Pref. between 1 and 60,000	10	6 %	6 %	6 %	6 %	12⅞ — 13⅛	12⅝ — 13⅜	..	..	..	4 7 8
99,261	Edison & Swan Utd., "A" shs., £3 pd., 1 to 99,261	5	Nil	2½%	4½%	4½%	1 5/16 — 1⅜	1 5/16 — 1⅜	..	..	— 1/16	10 5 7
17,139	Do. "A" shares, 01—017,139	5	Nil	2½%	4½%	4½%	2 — 2½	2 — 2 1/16 xd	..	..	..	8 6 9
819,475	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	81 — 84	79 — 82	79⅝	..	—2	4 17 7
72,220	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	87 — 90	87 — 90	88½	87⅞	..	5 11 1
112,100	Electric Contruction, 1 to 112,100	2	4 %	Nil	Nil	Nil	1/16 — 1/16	1/16 — 1/16	3/9	..	..	Nil
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390	2	7 %	7 %	7 %	Nil	½ — 1	½ — 1	12/-	..	..	Nil
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	4 %	5 %	5 %	5 %	8 — 8½	8 — 8½	..	..	..	5 17 8
200,000	Do. do 4 % Mort Deb.	Stock	4 %	4 %	4 %	4 %	89 — 92	89 — 92	..	..	..	4 19 11
78,000	Gt. N. & City Rail. Pref. Ord. "A" 4 %, 1 to 78,000	10	3 %	4 %	4 %	4 %	1½ — 1⅝	1½ — 1⅝	27/6	..	..	20 0 0
96,000	Greenwood & Batley, 7 % Cum. Pref.	10	7 %	7 %	7 %	7 %	10½ — 10⅝	10½ — 10⅝	..	..	..	6 10 8
80,000	Do. do. 5 % Mort. Debs.	100	5 %	5 %	5 %	5 %	102 —103	102 —103	..	..	..	4 17 1
200,000	Henley's (W. T.), Telegraph Works, Ord.	5	15 %	15 %	15%	15 %	10½ — 11⅛	10⅝ — 11⅛	11⅛	..	..	6 10 0
200,000	Do. do. 4½ % Pref.	5	4½%	4½%	4½%	4½%	5 — 5⅛	5 — 5⅛	..	..	..	8 17 3
150,000	Do. do. 4½ % Mort. Deb. Stock	Stock	4½%	4½%	4½%	4½%	105⅛—107⅛	105⅛—107⅛	107	..	..	4 3 9
50,000	India-Rubber, Gutta-percha & Telegraph Works	10	10%	5 %	10%	10 %	14½ — 15⅛	14½ — 15⅛	15	..	..	6 13 4
37,500	†Liverpool Overhead Railway, Ord.	10	1⅜%	1½%	Nil	Nil	1⅜ — 1⅝	1⅜ — 1⅝	..	..	..	Nil
10,000	† Do. do. Pref., fully paid	10	5 %	5 %	5 %	5 %	7⅜ — 8	8 — 8⅛	..	..	+ ⅛	5 17 8
600,070	London United Trams. (1901), 1 to 50,007	10	8 %	6 %	3 %	3 %	6⅝ — 7⅛	6⅞ — 6⅞	..	..	— ⅛	4 8 11
399,930	Do. do. 60,008 to 100,000	10	8 %	6 %	3 %	3 %	6¾ — 7⅛	6⅞ — 6⅞	..	..	— ⅛	4 8 11
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	5 %	5 %	5 %	5 %	7⅞ — 8⅛	7⅞ — 8⅛	..	..	..	5 17 8
1,381,000	Do. do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	82 — 86	82 — 86	82⅜	82½	..	4 13 0
314,016	Metropolitan Electric Trams., Defd.	1	Nil	Nil	Nil	Nil	1/16 — 3/16	1/16 — 3/16	1/3	..	..	Nil
500,000	Do. do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	1/16 — 1/8	1/16 — 1/8	16/-	..	..	5 6 8
350,000	Do. do. 4½ % Deb. Stock Red.	100	..	4½%	4½%	4½%	93 — 96	93 — 96	93½	92	..	4 13 9
245,500	Potteries E. Trc.	1	5 %	5 %	4 %	4 %	0/16 — 0/16	0/16 — 0/16	..	..	..	7 2 3
245,500	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	1/8 — 3/16	1/8 — 3/16	..	..	..	6 13 4
245,000	Do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	95 — 98	95 — 98	..	..	..	4 11 10
37,350	Telegraph Construction and Maintenance	12	20 %	15 %	15 %	15 %	27 — 30	27 — 30	..	..	..	6 0 0
150,000	Do. 4 % Ded. Bds., 1 to 1,500 Red., 1909	100	4 %	4 %	4 %	4 %	99½—102½	99½—102½	..	..	..	3 18 1
599,200	Undergd. E. R., Lon., 5 % Profit Shar. S. Nts.	..	..	5 %	5 %	5 %	38 — 42	34 — 38	40¼	38	—4	13 3 2
66,666	Willans & Robinson, 1 to 30,000 & 80,001 to 116,666	5	3 %	Nil	Nil	..	1 — 1⅛	1 — 1⅛	..	..	..	Nil
66,666	Do. 6 % C.P., 30,001 to 80,000 & 125,001 to 141,666	5	6 %	Nil	Nil	..	8½ — 3⅜	8½ — 3⅜	71/10½	..	..	Nil
246,574	Do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	75 — 80	74 — 79	..	..	—1	5 1 3

ELECTRICITY SUPPLY COMPANIES.

14,000	Bromley (Kent) E.L. & P,. 1 to 14,000	5	5 %	5½%	5½%	5½%	4⅝ — 5⅛	4⅝ — 5⅛	..	..	..	5 7 4
70,000	Do. do. 4½ % 1st. deb. stock	100	4½%	4½%	4½%	4½%	95 — 98	95 — 98	..	..	..	4 11 10
29,798	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	5	10 %	10 %	10 %	10%	7 — 8	7 — 8	..	..	..	6 5 0
10,202	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	7 — 8	7— 8	..	..	..	4 7 6
336,876	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	98½—101½	98½—101½	..	..	..	8 18 10
80,000	Charing Cross and Strand Electricity Supply	5	8 %	8 %	5 %	5 %	5⅛ — 4⅜	3⅛ — 4⅜	82/6	80/-	..	5 2 10
80,000	Do. do. do. 4½ % Cum. Pref.	5	4½%	4½%	4½%	4½%	3⅜ — 3⅞	3⅜ — 3⅞	78/9	71/3	..	5 0 0
80,000	Do. "City Undertaking" 4½ % Cum. Prf.	5	4½%	4½%	4½%	4½%	3⅜ — 3⅛	3⅜ — 3⅛	..	..	..	5 16 2
427,400	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	96 — 99	96 — 99	..	..	..	4 0 0
49,486	Chelsea Electricity Supply, Ord.	5	5½%	6 %	6 %	4½%	3½ — 4½	3½ — 4½	72/6	..	..	5 5 11
175,000	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	102 —105	102 —105	..	..	..	4 5 9
70,595	City of Londo Elec. Lighting, Ord. 40,001—110,595	10	5 %	6 %	6 %	6 %	8⅞ — 9⅛	9 — 10	9⅛	9 7/16	+ ⅛	6 0 0
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	10½ — 11⅛	10½ — 11⅛	..	..	..	5 11 8
400,000	Do. 5 % Db. Stk., Scrip. (iss. at 115) all pd.	..	5 %	5 %	5 %	5 %	122 —125	122 —125	..	..	..	4 1 4
800,000	Do. 4½ % 2nd. Db. Stk., Prov. Crts., all pd.	100	4½%	4½%	4½%	4½%	95 — 98	95 — 98	97½	96	..	4 11 10
40,000	County of Durham Electrical Power, Ord.	5	4 %	£3 7 0	4 %	4 %	3½ — 4½	3½ — 4½	..	..	..	4 14 1
50,000	Do. do. do. 5 % Pref.	5	5 %	5 %	5 %	5 %	4⅜ — 4⅝	4⅜ — 4⅝	..	..	..	5 2 7
40,000	County of London Electric Lighting, Ord. 1—40,000	10	4 %	4½%	4½%	5 %	6½ — 7¼	6½ — 7¼	..	..	..	7 2 10
40,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	6 %	10 — 10¾	10 — 10¾	..	..	..	5 11 8
400,000	Do. do. 4½ % Deb. Stock	..	4½%	4½%	4½%	4½%	106 —109	106 —109	..	..	..	4 2 7
400,000	Do. do. 4½ % 2nd. Deb. Stock	Stock	4½%	4½%	4½%	4½%	95 — 98 xd	95 — 98	107½	105½	..	4 11 10
80,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	4 %	Nil	½ — 1	½ — 1	..	..	..	11 0 0
80,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	3 %	1 — 1⅜	1 — 1⅜	27/6	..	..	8 11 5
350,000	Do. do. 4½ % 1st Mort. Deb. Stk.	100	4½%	4½%	4½%	4½%	76 — 81	76 — 81	..	..	..	5 11 1
10,000	Folkestone, 1 to 10,000	5	5½%	5½%	5½%	5½%	4⅜ — 5⅛	4⅜ — 5⅛	..	..	— ⅛	5 7 4
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	..	..	5 %	5 %	4⅜ — 5⅛	4⅜ — 5⅛	..	..	..	4 13 0
90,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	96 — 99	96 — 99	..	..	..	4 10 11
13,000	Hove, 1 to 13,000	5	8½%	8½%	9 %	9 %	6½ — 7 xd	6⅝ — 7	..	..	..	6 8 7
21,000	Kensington and Knightsbridge Electric Ord.	5	12%	12 %	10 %	10 %	8½ — 9¼	8 — 9	..	..	— ½	5 11 1
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	95 — 98	95 — 98	..	..	..	4 1 8
111,000	London Electric Supply Corporation, Limited, Ord.	3	Nil	3 %	4 %	4 %	1¾ — 1⅞	1¼ — 1⅜	..	..	..	6 16 2
70,000	Do. do. do. 6 % Pref.	5	6 %	6 %	6 %	6 %	3⅜ — 4¼	3⅜ — 4¼	..	..	..	7 1 2
374,395	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4 %	4 %	4½%	89 — 93	89 — 93	..	..	..	4 16 9
200,000	Metropolitan Electric Supply, 1 to 100,000	5	8½%	10 %	10 %	8 %	5½ — 5⅝	5½ — 5⅝	5⅝	..	..	6 19 2
76,121	Do. 4½ % Cum. Pref. 1—71,106	5	4½%	4½%	4½%	4½%	4⅛ — 5	4⅛ — 5	..	..	..	4 10 0
220,000	Do. 4½ % 1st Mort. Deben. Stock	..	4½%	4½%	4½%	4½%	103 —107	103 —107	..	..	..	4 10 0
250,000	Do. 3¾ % Mort. Deben. Stock Redem.	Stock	3¾%	3¾%	3¾%	3¾%	87 — 92	87 — 92	..	..	..	4 16 1
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	4½%	98⅜ — 98⅝	98⅜ — 98⅝	..	..	..	4 11 5
87,500	Newcastle-on-Tyne, 1 to 87,500	5	8 %	8 %	8 %	8 %	6⅛ — 6⅜	6⅛ — 6⅜	..	..	..	5 18 6
87,500	Do. 5 % Pref., 1 to 87,500	5	5 %	5 %	5 %	5 %	5 — 5⅛	6 — 5⅛	..	..	..	4 10 11
10,852	Notting Hill Electric Lighting	10	6 %	7 %	7½%	7½%	10½ — 11⅛	10½ — 11⅛	..	..	..	6 10 5
20,000	Oxford, 1 to 96 and 407 to 20,310	5	6½%	7 %	7 %	7 %	5⅜ — 6	5⅜ — 6	..	..	..	5 16 8
50,000	Do. 4 % Deb. Stock	100	4 %	4 %	4 %	4 %	95 — 97	95 — 97	..	..	..	4 2 6
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½%	12½%	10 %	7½ — 8¼	7½ — 8¼	..	..	..	6 1 3
20,000	Do. do. 7 % Pref. 20,081 to 40,080	5	7 %	7 %	7 %	7 %	6 — 7	6 — 7	..	..	..	5 0 0
150,000	Do. do. 3½ % Deb. Stock Red.	100	3½%	3½%	3 %	3½%	86 — 91	86 — 91	..	..	..	3 16 11
12,000	Smithfield Markets Electric Supply, Ord.	5	4 %	4 %	4 %	Nil	½ — 1⅛	½ — 1⅛	..	..	..	Nil
50,000	Do. do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	71 — 75	71 — 75	..	..	..	6 0 0
65,000	South London Electricity Supply, Ord.	5	3 %	4 %	4 %	3 %	2⅛ — 2⅜	2 — 2⅛	45/-	42/6	— ⅛	6 0 0
120,000	South Met. Elec. Lt. & Power, Ord.	1	Nil	Nil	2½%	2½%	1/16 — 3/16	1/16 — 3/16	..	..	..	3 6 8
117,968	Do. do. 7 % Pref.	1	7 %	7 %	7 %	7 %	1/16 — 1 1/16	1/16 — 1 1/16	..	..	..	5 17 11
200,000	Do. do. 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	4½%	99 —102	99 —102	..	..	..	4 8 3
80,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	5 %	1⅜ — 2⅛	1⅜ — 2⅛	..	..	..	11 10 6
50,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	1¼ — 2⅛	1⅛ — 2⅛	..	..	..	8 13 1
200,000	Do. do. 4½ % 1st Mort. Db. Stk. Red.	100	..	4½%	4½%	4½%	92 — 95	92 — 95	..	..	..	4 14 9
110,000	Westminster Electric Supply, Ord.	5	13½%	14 %	13 %	12 %	8½ — 9½	8 — 9	..	..	— ½	6 13 4
81,279	Do. do. 4½ % Cum. Pref. (Original 5 %—Red. to 4½ % from 31st Dec., 1905)	5	5 %	5 %	5 %	4½%	4½ — 5½	4⅝ — 5¼	..	..	..	4 5 9

* Unless otherwise stated, all shares are fully paid. † Quotations on Liverpool Stock Exchange.

Bank rate of Discount 7 per cent. November 7th. 1907.

THE THURY DIRECT-CURRENT TRANSMISSION SYSTEM.*

By D. KOS.

This system was practically operated in 1889 in Genoa (Italy), since which time various other transmission plants have been added with constantly increasing voltages. The two best known examples are the St. Maurice-Lausanne transmission (Switzerland), with 22,000 volts, and the Moutiers-Lyons transmission (France), with 57,600 volts. In the last-mentioned plant there are in the generating station four hydraulic turbine-driven units, each consisting of four generators. The individual generator E.M.F. is 3,660 volts, the E.M.F. of the system being 57,600 volts. By grounding one line the voltage can be doubled later on. The transmission line consists of 180 kilometres of overhead copper wire circuit, with conductors of 9 mm. diameter and 4 kilometres of underground cable circuit, the cable having a cross-section of 75 sq. mm. Hence, the total resistance of the entire circuit is 100 ohms, and the line drop amounts to 7,500 volts, the constant current being 75 amperes. The loss at full load is 13 per cent.

A more ambitious project is to provide Paris with power from the rapids of the Rhone, near the Swiss frontier. A voltage of 140,000 is being contemplated, with the neutral point grounded. Taking equal maximum potential from wire to ground as a basis of comparison, this is the equivalent of 85,000 volts (wire to wire) three-phase, a value slightly exceeding recent practice in this country. As far back as 1901 an experimental direct-current generator was built and used for testing purposes in connection with the St. Maurice-Lausanne plant, which generated 22,000 volts.

The distinguishing feature of the Thury system is that the current is kept constant, which is accomplished by motor-operated regulators, cut in or cut out by relays, consisting of electro-magnets through which a certain fixed part of the current flows, and which operate as soon as the current varies either way from its normal value. The torque necessary to produce a current in a series generator is proportional to the current and the magnetic flux, which latter again is a function of the current. Thus, considering a prime mover with constant torque under all speeds and no speed regulation, when the current increases through some decrease of the load in the receiving stations, the prime mover must slow down. This will result in a lower E.M.F. of the generator and consequently in a lower value of the current, which will again reach its normal value. When the current decreases the prime mover will speed up, and so restore its original value. Consequently, there exists a tendency toward self-regulation which, of course, must be assisted by a regulating device, operated by the current itself, that will change the speed of all prime movers simultaneously so as to give such an E.M.F. as will produce again the required constant amperage.

Instead of changing the speed, one can also change the flux, the E.M.F. being proportional to the product of the two. The flux may be changed by weakening the field current through a shunt device, or, as was done in the first Thury installation in Genoa, by providing a separate common exciter, the speed of which is controlled by the regulating device. This last solution is the simplest of all, but would be too difficult for real high tension work, because the exciter circuit must be connected to all of the generators with their very different voltages from ground, which would result in exceedingly expensive insulation of the field coils from the frame.

The E.M.F. could not very well be reduced by means of field weakening below 66 per cent. of the maximum value, on account of sparking difficulties, so that further reduction must be accomplished by moving the brushes along the collector, or by cutting part of the generators out of the circuit.

With hydraulic turbines there is no need for these things because the solution involving speed regulation has been worked out in a satisfactory way for this class of prime movers. At lower speed the efficiency decreases considerably, but this is not disadvantageous for hydraulic plants without a storage reservoir.

There is only one regulator for all the turbines, or two in case the central point is grounded, as the loads on the two halves may then differ from each other. The Thury regulator is a complicated piece of machinery, but so are all water-wheel governors; and the fact that only one (or two) must be used, results in a great saving as compared with a plant of many units, where each turbine has its own expensive governor. As the Thury system, moreover, requires very little apparatus, and does away with bus-bar galleries, endless rows of oil switches, numerous switchboard panels with complicated apparatus and wiring, and also with transformers and accessories, the saving should more than balance the greater cost of direct-current generators, with their relatively expensive insulation and greater sub-division, and with several generators for one turbine, as compared with three-phase generation. Moreover, there is a saving in the size of the station building, which is, of course, much smaller in the absence of the things above mentioned.

For the motors in the receiving stations, constant speed is in most cases required. There is no tendency toward self-regulation in the motor itself. The torque of a series motor is proportional to the current and the field flux, and hence with a constant current is constant save for variations in the efficiency with different speeds. Consequently, when the motor load is decreased, the motor tends to run away, and when the load is increased, it tends to come to a standstill.

Of course, if the load is a generator supplying a secondary system with energy, an increase of speed would mean an increase of both the secondary E.M.F. and current, and consequently an increase of the motor load, which would speedily create a new condition of equilibrium. A decrease of speed will decrease the motor load in a similar way. At any rate, it may be expected in this case that the secondary voltage will fluctuate heavily. The regulating device for motors is also motor-driven, but its relay is operated by an ordinary centrifugal governor, receiving its speed from the motor-shaft. The only possible method of regulation is to change the field flux, which is mostly done by shunting the field current until the counter E.M.F. is reduced to 66 per cent. of its full value, and after that by changing the brush position. It will be seen that the motor cannot be overloaded, even for a short time, which is a serious disadvantage, especially for electric railway work.

The necessity of motor regulation is a great drawback to the Thury system. The writer of this article had occasion, a few years ago, to visit frequently one of the older and smaller Thury plants (in Batoum, Russia)* and was surprised to find the plant running reasonably well with all the regulating devices in both generating and receiving station disconnected, the operators not knowing how to repair them. As far as the generating system is concerned, this is not surprising after the theoretical considerations given above, but the motors in the receiving station, driving direct-current generators, which supplied current for a 2 × 110-volt lighting system without a battery in parallel, operated with some hand regulation by the attendant. The secondary voltage was not very constant, but still it was tolerable and by no means worse than what one sees in many small towns. With better operators, the result might have been even better.

In most of the large Thury systems, the secondary systems are three-phase for motor and lamp service, and the regulator seems indispensable. When the motor is used to drive a generator employed for battery charging, the regulator is unnecessary. Probably for any direct-current system with a battery in parallel, the regulator could also be dispensed with. When the direct-current system is used solely for railway purposes, where the voltage need not be so very constant, it might be practicable, in case of an emergency, to operate without the regulating device, even when there is no battery, but the heavy and sudden fluctuations of load which may be expected in this case would make the outcome doubtful.

Comparing three systems, namely :—(1) Direct-current series system with neutral point grounded. (2) Direct-current series system with ground return. (3) Three-phase system.

The basis for comparison of the three systems being an equal maximum E.M.F. from the wire to the ground, and assuming that the three-phase transmission has a power-factor of 0·8, either one of the direct-current systems considered would require only ·32 of the line copper necessary for the three-phase system. Strictly speaking, it would be still a trifle less, because none of the extra losses peculiar to alternating current (skin effect, dielectric hysteresis, &c.) will occur.

The number of insulators required, compared with three-phase, is one-third for direct current with ground return, and two-thirds for direct current without ground return. This also makes the pole construction simpler, especially when, as in accordance with very recent practice, suspended insulators for very high voltages are used, since it is simpler to make a cheap pole construction for two wires than it is for three. Both these factors mean a great additional superiority in line economy for the Thury system. As there is less liability of excessive voltages caused by surges in a direct-current system, the factor of safety can properly be taken less than that which is customary for alternating-current lines, which would mean cheaper insulators; the usual factor of safety of insulators for high-tension lines being often criticised as being somewhat low, it is perhaps better not to do so, but that would mean again greater safety against insulator trouble, when direct current is used. The line loss of the Thury system is the same in watts for all loads, and, consequently, the loss per cent. is inversely proportional to the load. With an ordinary alternating-current parallel system, the line efficiency is, on the contrary, better instead of worse when the load is less than full load. This is a great argument against the Thury system when steam or water power with storage is used; for water power without storage it does not make any difference.

The foregoing considerations, which tend to show the superiority of the Thury system, apply only to cases where all the power is transmitted in bulk to the extreme end of the line. When it is intended to distribute the energy over many sub-stations, it will be seen that the advantage disappears to a certain extent. In a series system it does not make any difference whether the power has to be transmitted to the extreme end or part of it to intermediate points, the loss in watts remains always the same, because all of the current has to go through the entire line. In order to be able to make a comparison with the parallel system, we assume a line which distributes its power equally along its length, *i.e.*, the sub-stations are supposed to be equidistant and of equal size.

For approximately equal or uniform distribution of power along a line, only about half the copper is necessary that would be required for transmission of the total power to the end of the line.

For transmission in bulk the ratio of line copper required respectively by the three-phase and the Thury system was found to

* *Electrical World.* Abstract.

* This installation has two dynamos, each rated at 100 H.P., 50-ampere maximum E.M.F. = 2,600 volts; distance of transmission, seven miles.

be $\frac{2}{\cos^2\theta}$ in favour of the Thury system'; for equal distribution it is only $\frac{1}{\cos^2\theta}$.

The following table gives values for different power-factors. The ratios in the cases considered will be seen to vary from 1 to 4·08 in favour of the Thury system:—

Cos θ	1	·95	·9	·85	·8	·75	·7
Ratio for transmission in bulk	2	2·22	2·47	2·77	3·12	3·55	4·08
Ratio for equal distribution	1	1·11	1·23	1·38	1·56	1·77	2·04

With equal distribution and a high power-factor the advantages of the Thury system in respect of copper economy are very slight. If the greatest part of the power is taken on the first part of the line, three-phase is decidedly superior. The direct-current series system, on the other hand, will give good results when most of the energy is delivered at the farther end. In the European Thury installations, almost invariably nearly all the power is delivered to the extreme end, but small blocks of power are taken off *en route*. The popular objection that the Thury system is only practicable for transmission between a generating station and one receiving station is unwarranted; but it is only desirable to use this system when the sub-stations are more or less concentrated near the end of the line.

A diagram, giving the potential between the two wires and ground, is shown in fig. 1 for a direct-current series distribution

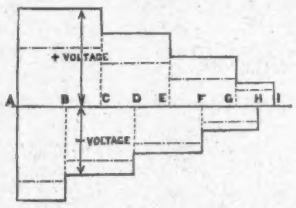

Fig. 1.—Potential Difference between two Wires.

with neutral points grounded. The line AI represents the transmission line; C, E, G and I are sub-stations on the positive wire; B, D, F and H are sub-stations on the negative wire. Between H and I one wire is grounded. The ordinates on either side of the ground potential line give the positive and negative voltages of the respective wires. It will be seen at a glance that only a limited stretch has full voltage between wire and ground. Near the end of the line the voltage is quite low, and between H and I there is no voltage at all on one of the two wires. The diagram is supposed to be drawn for full load on all stations; if the load of any or all decreases, this can only result in a still lower voltage, as indicated by a dotted line. Consequently, high-voltage insulators are only necessary on part of the line, and various cheaper kinds, designed for lower voltage, can be used on each succeeding section. This illustrates in an indirect way that for wide distribution the full benefits of the Thury system cannot be realised. The line is only a high-tension line at the start, but degenerates into a low-tension line towards the end.

Under such circumstances the advantages of direct-current are more or less neutralised by the use of the series system. A direct-current parallel system would take in all advantages, but as each sub-station would necessarily require a sub-division of the voltage over many motors, it would be hardly practicable, save in the case where there are only one or two large receiving stations. With one receiving station only, it is, of course, identical with the series system.

Quoting from an article on the Thury system in the *Electrical World* of August 27th, 1907, p. 352:—"A principal source of trouble with the direct-current transmission system is from lightning on the overhead lines. This is, however, a source of trouble with almost all transmission lines in Switzerland, and there seems to be no reason for supposing that the trouble is increased in the case of a direct-current system."

However, it would seem that a static discharge may be much more destructive when it finds its path through a motor of the Thury system, than when it lands in an oil-filled high-tension transformer. In a grounded station, the discharge finds its way to earth through a series of generators or motors, where it is liable to work much havoc, but in the alternating current station it would have to work its way through a strong insulation, while the oil will smother any arc which might occur if it succeeded. Consequently, it would seem that much more care should be given to protection of Thury stations than is customary for alternating-current stations. Choke coils can be introduced in a direct-current system without any other loss than that caused by ohmic resistance. The main source of trouble, the line itself, offers the same opportunity to lightning, no matter whether direct current or alternating current is used.

Where the alternating current has its overload relays, reverse-power relays, &c., the Thury system has its over-voltage short-circuiting switch, excess speed short-circuiting switch, and inverse rotation short-circuiting switch. The latter should be more reliable than the reverse-power relay, because it is actuated by direct current, and hence there is no possibility of it becoming inoperative in case of trouble, because there is no angle of lag which can suddenly jump to nearly 90°. Furthermore, there can be no surges on account of resonance and other troublesome alternating current phenomena.

A more or less prevailing opinion that the Thury system should be less reliable, because all of the current has to go through each individual sub-station and through each individual motor in those sub-stations, is, of course, not correct. If in a parallel system a sub-station or transformer is troubled by a short-circuit, it will have to be disconnected, for instance, by an automatic circuit-breaker, or otherwise the whole transmission system will suffer. In the same way, when the current is interrupted in a Thury sub-station or one of its motors, the automatic short-circuit device must operate to let the current pass by. Supposing the automatic circuit-breaker and the automatic short-circuiter to be of equal reliability, it can hardly make any difference whether all of the voltage or all of the current is admitted in each sub-station, as is respectively the case in the two systems.

In respect to line breakdown, the three-phase system with grounded neutral has very little that is commendable. If one of its three wires breaks or gets grounded, the entire service is interrupted until repairs can be made. To be sure, operation with two wires and ground is theoretically possible, but this is seldom attempted, and it is of slight practical value. As a rule, where continuity of service is an important factor, a duplicate line is provided. Mr. E. J. Young (*Transactions* A.I.E.E., May, 1907) proposes for that reason a single-phase transmission with grounded neutral, which for the same voltage between ground and wire, obviously has the same line economy as the three-phase system, and by means of a system of double-pole, double-throw switches for every transformer, continuity of service is assured when one of the line wires breaks down. If the two wires were carried on separate poles or structures, continuity of service would be almost certain, as it would take two coincident accidents to cause an interruption.

Such favourable conditions cannot be realised with the Thury system. If only one wire and ground are used, a breakdown will give a complete interruption, at least in that part of the line which is beyond the break. If there are any sub-stations between the power house and the point of trouble, the line should be grounded at the last sub-station on the generating station side of the break, in a grounding cabin, which should be installed in every sub-station. Pending repairs, the first part of the system could continue to give service. Where continuity of service is of great importance, a duplicate line must be installed over the entire stretch, entailing 100 per cent. extra line investment. When two wires and a grounded neutral point are used, conditions are better, as only one extra line, or 50 per cent. extra line investment, would be required to ensure continuity of service.

In the Lyons-Moutiers installation as yet no grounded central point is used, the present plant being considered one-half of the future plant, or at least it has been laid out with that possible end in view. At present when one of the two wires breaks down, the return can be made through ground, so that no extra provisions are necessary to ensure continuity of service. But, at the same time, it is practically equivalent to a 30,000-volt installation and has 60,000-volt insulation.

In the Paris transmission scheme, which involves the grounded central point, it is considered sufficient that one-half of the power supply can be continued if one wire breaks down. The two wires will be carried on separate pole lines, to exclude the possibility of the two wires being disabled at the same time.

FAULT FINDING. OR GONE TO EARTH. TALLY HO!

By M.

We have the pleasure of reading from time to time in technical papers, articles describing the writer's pet method of localisation. These for ideal or theoretical conditions may all be very extra especially good, but when one meets with such conditions as those described below, the desire to have the authors of infallible tests on the spot—and keep them until the trouble is located—becomes intense.

There is one town in which Fate has directed that I should gain further experience in cable work, where one may take one's choice of earths from a large variety—call and see them next day, and find them "out," or so disguised as to be unrecognisable. Thus, one night, one of my assistants telephoned to say that a consumer was in darkness: he, the assistant, had carefully examined the apparatus, the fuses were intact, no loose leads could be found, and yet there was no light—nay, more, he had put his fingers on to the live pole and found it dead!

There had, to my certain knowledge, been no trace of an earth for many days, and there was no report of more consumers on the same cable being shut down; without either of these it seemed inconceivable that a lead-covered triple-concentric cable should have suffered through discontinuity to the centre core! I asked, more or less politely, through the telephone, if my assistant was absolutely sure of

his statements—of course "Yes" was the reply, and so there was nothing for it but that I should turn out. First I proceeded to the installation, put my hands on the live pole (damp boots be it noted, and the position in a public-house cellar), then one hand on each pole across 230, and then one hand with damped fingers on *both* poles. The only result was a very faint shock, apparently "leakage." After cutting the insulation below the fuse-boxes, to make sure that the fault was not in the sealing chamber, and again trying for a shock, I decided that it was a fair case for the mains gang, and so turned them out.

After hanging about for some time waiting—in fact, until the mains kit had come more than half way from the works—I chanced to feel a bit of light fuse wire in my pocket, and thought I might as well shove it across the house fuses to see what the leakage current might be. Result a flash—healthy enough to assure one of the pressure of 230 volts—(still no shock to be felt). In starting back at the flash, my assistant I think it was, found cause to grumble as he knocked his head violently against the main switch situated on some joists. "Thank you so much," came a voice down the stairs; "the light is on again now!!!" Corrosion of the main switch of course had caused absence of light, but the shocking question so absorbed us that this was overlooked.

Next day the cellar was apparently in exactly the same condition, outside weather the same—only the shocks had changed—they got right there! So much for that variation of earth.

My mains experience on the whole has not stimulated me to faith in any theoretical tests for fault location. One fault dealt with recently consisted of a partial discontinuity and earth on a cable laid on the solid system in iron troughs. For testing purposes there were the conveniences of our own neutral earthed without resistance at the works, the tramway rails, and the earth wires on two poles, one used for telegraphs and the other for telephones. Of course, in addition there were the iron troughing and the damp soil. We tried our luck with each, I think, with a Varley loop or one of its numerous variations; we tried resistances to each earth with various currents and in various ways. Every test gave a different result, so the proceedings ended in trying for shocks at different points—result, fault located promptly!

On inquiry into the condition of the particular town in which this location was carried out, I heard that two plates in accordance with the B. of T. regulations had been sunk with all care in the bed of a river, then 500 volts was put between them for amusement, and a current of 10 amperes was the only result.

The traction is connected to these two earths, the rails apparently make quite a different earth judging by the recorder, the pipework in the station gives another variety, and the official lighting earth is a fifth. Supposing a leakage occurs on the lighting: immediately the traction recorder assumes a definite false zero, and a traction cut-out indicates on both earth recorders. Armour and lead tend to increase the variety of earths by two different degrees. It takes much experience in ferriting to stop all the earths bar the main one.

In spite of this, one solid system outer fault has been located by a test on a 100-in. low resistance bridge, and one with a 500-in. bridge, the former coming out within the space of the smallest hole which could be opened out in the street, the second within a yard on a 1,200-yard complete loop, the length being only approximately known, scaled off an ordnance map, and the usual percentage added for bends.

These two good locations bear out my argument, because they were carried out successfully, owing to the many conditions which upset a test being absent.

Another series of faults I have dealt with, pleased me exceedingly—the neutral was nearly permanently earthed with faults, when I took charge of the network, whilst the outer followed suit on all available opportunities. When I left but one neutral earth remained, and that was located dead on.

Several mains engineers happened to make the town a temporary stopping place, and I consequently had the chance of absorbing much of the earth lore, and of hearing of many runs to earth—*always* in at the kill. Naturally, a challenge of any pet location method followed whenever possible—and sitting on the jointer's tool-box by the fire devil I heard tales of ventures at home and across the seas, extremely interesting, but the fire devil was nearer to us than the location given by the pet tests—we spun yarns whilst the jointer was warming himself with practical fault-finding after shivering through theory. Was it luck that I usually managed to get things going well without serious inconvenience to consumers? Experience is worth a lot more than theory in both fox and fault hunting.

Perchance it may interest some to know the successful methods employed on some faults. They were many and various, the *modus operandi* being to think of ridiculous things and then go and do them. One member of the staff was rather useful—he was rather sensitive to shocks, and wore thin boots—location, dead on and no time wasted. Burning the fault before testing is always recommended; it helps things along, and one long joint often takes more time than two splices. We simply kept the current on until the electric heater had time to work, a bucketful of water on the pavement as a next step was effective, steam is a moderately good locater.

If the fault had pleasantly nearly chawed up all one's fuse fittings in the near neighbourhood, and seemed likely to do so again on the smallest attempt at nourishment, a convenient method was using sense of smell; put a bar in the ground over suspected places and smell it when withdrawn—there is not much chance of mistaking the odour! We often thought of training a pack to run the scent to ground.

Of the other senses, hearing has located the position of an actual earth contact, although this happened to be 4 ft. away from the point of fault leakage. I have only within the last few days tried the sense of taste for locating; a very small fault was on, and the effect hardly visible when actually opened up. Taste of compound lead and paper gave the exact spot.

Of all the senses, the one that the budding mains engineer should exercise chiefly is common sense. One thinks a lot and says little, or uses unparliamentary language at all wandering electrons, or whatever else they may be, and thinks that one will be extremely glad when on a job where there are no faults to find, but, all the same, a "network" surrounds one's heart, and one remembers with longing; perhaps mains engineers have special little stray earth currents granted to them to keep them cheerful when tucked away in the graveyard and, later on, their own special network will develop faults which will always be correctly located, without a single consumer saying——bless words. The weather will be perfect, the runs perfect, when we've all gone to earth. Tally ho!

SOME ECONOMICS OF TRANSPORTATION IN THE BRITISH ISLES.

[COMMUNICATED.]

THE threatened displacement of steam by electricity, involving an enormous increase of capital in many of the existing steam-worked railways through the adoption of long-distance electric traction, should surely give us ample reason to ponder the economical questions involved in such a change ere the leap in the dark is actually taken. Already, notwithstanding a fairly rigid adherence to the railway manager's pet nostrum for the cure of fading earnings, *i.e.*, making each trade pay the highest rates that it can be made to bear, the proportion of working expenses to gross receipts has become a steadily increasing quantity, while dividends are as steadily dwindling. To this must be added the ever-increasing demands of the staff which works our railways, and of the distinguished representatives; there seems no call for an increase of capital to lend additional gloom to the outlook which confronts both railway managers as well as the actual and prospective holders of railway securities. On the other hand, one of the most crying needs of the hour, and one which the future can only intensify and not diminish, is the question of cheap transportation

within the limits of these Islands. Without internal cheap transportation, the hope of successfully holding our own in international commercial competition is illusive indeed, and our fate cannot remain for long in doubt. Cheap transportation, both for passengers and goods, within the narrow limits of our shores we must have, or we are bound to witness before very long the occurrence of a parallel sequence of events affecting our manufacturing industries essentially similar to those which have already taken place with reference to our agricultural industries. Our rural districts have been steadily depopulated as the combined result of the competition of cheap foreign grown produce and dear inland freights. In the international race of the world against any one country, it is always the former which sets the pace, or, in other words, it is always the imported article which rules the price of the home products, whether the country under consideration be Free Trade or Protectional.

Under the combined effect of the competition of cheap foreign manufactured goods and dear inland freights for home manufacturers, the depopulation of our towns is as sure to ensue as that of our rural districts; it can only be the question of a comparatively short time. Whenever manufactures are carried on at a more or less remote distance from the places where the raw materials for those manufactures are produced, and similarly whenever the factories where workmen are employed lie at a more or less remote distance from where they dwell—manufacturing is carried on under essentially wasteful conditions, exists under essentially artificial circumstances, and can only subsist provided the cost of transportation is reduced to, and maintained at, a minimum figure. Under any other circumstances the forces tending to disintegrate and break up the artificial conditions so greatly exceed those tending to preserve and perpetuate them that the former must inevitably and quickly prevail.

It is obvious, therefore, that as a condition precedent to our continuing to occupy the eminent position among manufacturing nations which we have secured during the past century, we must reduce the cost of our inland transportation to a more reasonable figure. Our failure to do this in the past has already helped to reduce our at one time most important agricultural industries to a moribund condition, has largely depopulated our country districts, and is fast reducing them to an uncultivated waste. Our failure to do so in the future will just as inevitably help to reduce our great iron and textile industries to a similar moribund condition and will depopulate our manufacturing districts and rapidly reduce our towns, more or less, to aggregations of dilapidated tenantless houses. It is curious to note that while the policy by which all classes of foreign produce, raw and manufactured, are allowed to enter our ports as freely and as inexpensively as possible has been rigidly adhered to for nearly seven decades, its obvious corollary, the policy of securing the unhampered and inexpensive distribution of all classes of produce inland, and the delivery under similar conditions of the articles of home production at the seaboard for exportation, has been just as rigidly ignored. The advantage to the general population arising from the deliberate relinquishing by Government of its prescriptive right to the taxation of all produce crossing the frontiers of the State, to the extent to which it has been abandoned in these islands in recent times, has been more than set off by the deliberate creation of private monopolies possessing the prescriptive right to tax all produce in transit to and from those frontiers, to an extent only limited by the capacity of the goods to pay the charges levied on them. Over the Government monopoly in taxation the Constitution provides some remedy, and in any case the proceeds form part of the public revenue, and serve to meet public expenditure, but over the private monopolists and the revenue they raise to render a semi-public service, often unnecessarily inflated from wholly private reasons, the control afforded by the Board of Trade and the Railway Commissioners has proved both illusory and unsatisfactory. This inflation of expenditure with its unavoidable corollary of excessive tolls is, no doubt, curing itself in the case of railways, as it did in the case of canals, by the slow process of the progressive depreciation of the stocks representing the capital value of the respective undertakings, analogous to the self-amputation or sloughing of a wounded limb. But in the meantime, in the former, as in the latter case, the subject of this slow process of amputation, the manufacturing and producing public, runs serious and unwarrantable risks of blood poisoning and consequent premature decease. Internal transportation has been effected in civilised countries as far back as history runs by means of either landways or waterways. To increase the speed and reduce the cost of collective traction on landways, the railroad and the tramroad have been evolved, and to a large extent an unmistakable tendency has been developed by which these have superseded their common ancestor, the ordinary road.

The recent development of automobile traction may, very probably provide a wholesome check upon this tendency in the immediate future, notwithstanding that it is unlikely to prove a satisfactory substitute for traction on railroads or tramroads, especially where traction in bulk is within the bounds of possibility, and these always must remain the only really economical form of land carriage for heavy and bulky merchandise handled in large quantities.

We may possibly see an effort made before long to provide special roads for automobile traffic, at least of the pleasure variety; for although the Bill presented to Parliament two years ago for an automobile road from London to Brighton fell through, it, or others like it, will almost certainly be reintroduced before long. In many parts of the United Kingdom the remains of ideal tracks for automobile traffic actually exist in the shape of derelict Roman military roads. These would possess, if properly repaired, the best qualifications for such a traffic, being generally straight from point to point, long distances apart, and closely following the lines of the watersheds. The Romans, no doubt, selected these locations for their main lines of communications, because it was cheaper to construct roads, maintain and defend them in an uncleared country when they closely followed the ridges and avoided the valleys, than under the reverse circumstances, and our word "high," that, is "elevated" road, is a legacy of the conditions which produced these early main roads.

The rehabilitation of the ancient Roman roads would be not only a sensible and economic improvement, which everyone would welcome, but it would also lead to a more or less ideal differentiation in automobile traffic, the new automobile roads being used for high-speed passenger traffic, leaving the older main roads to the slower and bulkier traffic of goods and passengers carried by the motor-lorry and omnibus. For these new automobile roads the excellent, though antiquated, system by which the cost of the roads and their maintenance were defrayed directly by the traffic, might very reasonably be reintroduced with some suitable system of control, so that the improvement need not cost the over-burthened local taxpayer anything.

It were very well for our Islands if circumstances had favoured progress in water-traction as efficiently as it has done that of land-traction in the last three-quarters of a century. Having made a marvellous start in the three-quarters of a century immediately preceding the last, water-traction has unluckily remained stagnant, if it has not actually retrograded ever since.

It is now questionable whether by any means within the limits of practical measures that could be legitimately adapted either privately or by the State, the ground lost in the development of internal waterways could be retrieved. The vague impression that something might and ought to be done in this connection, seems to have captivated a section of the thinking public, and has reacted upon the Government of the day, producing the usual Royal Commission with the promised panacea of an extra voluminous report, and one or more volumes of evidence, which very few besides the Secretary and the witnesses will ever take the trouble to read through. It is our intention to return to the consideration of the report and volume of evidence, which has been up till now issued by the Canal Commission, at an early date, and at some length, for we are convinced that electric traction can alone provide the requisite means for resurrecting our inland waterways and bestowing on them a fresh lease of life.

All that we will add here is that if canals are in the future to take their proper share in the general scheme of inland traction, they will have to be altered in structure and method of working, so that, first, the traffic on them will

move at an average speed exceeding 10 miles an hour; and secondly, so that barges can be worked in trains instead of single units, or, in other words, they will have to be adapted to the conditions of transportation in bulk characteristic of all up-to-date commerce. It is curious that the practical solution of both these desiderata has been practically in sight for more years than we should care to point out, and yet that its application should only have been made possible by the advent of electric traction.

ALUMINIUM AS A SUBSTITUTE FOR COPPER FOR ELECTRICAL TRANSMISSION PURPOSES.

By JOHN B. SPARKS.

(*Concluded from page* 798.)

High-Tension Cables.—For the sake of comparison let us compare the costs of aluminium and copper cables for high-tension work.

In fig. 1 curves were given, expressing the cost per km. of insulation, lead and labour, &c., as a function of the section of core for low-tension single-core cables.

Corresponding to this we have fig. 3, which gives curves expressing the cost of insulation, lead and labour as a function of the section per core and the voltage between cores for high-tension, three-core cables.

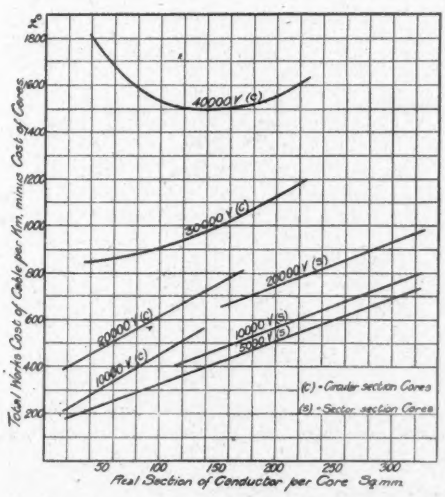

Fig. 3.—Cost of Insulation, Lead-Covering, and Labour for Three-Phase Three-Core H.T. Cables.

It will be noticed that there is a break in the curve for 10,000-volt cables, also in that for 20,000 volts.

This occurs when the cores are stranded to a sector-shaped section, thus effecting a saving in insulation.

Where the amount of insulation is very large in comparison with the section of copper, it would not be economical to construct the cores in this way.

It will also be noticed that at very high voltages the cost of the cable, after a certain section is reached, increases with *decreasing* section of core, as the increasing curvature of the conductor calls for an increased thickness of insulation.

Let us, as in the case of low-tension cables, estimate one particular case in full: for example, a three-phase three-core cable to transmit 800 KW. at 10,000 volts between cores with a loss of 0·3 per cent. per km.

A copper cable for this purpose would have a section of 50 sq. mm. per core.

(A) *Copper.*

Section of core	50 sq. mm.
Weight of all three cores per km. (allow 3 per cent. for stranding) = $50 \times 8{\cdot}9 \times 10^{-3} \times 3 \times 1{\cdot}03$ ...	1·38 tons
Take cost of copper wire per ton at £100.	
Cost per km. of 3 × 50 sq. mm. cores	£138
From fig. 3, cost of rest of cable per km.	£310
Total cost of cable per km.	£448

An aluminium cable of equal conductivity will have a section per core of $\frac{50}{0{\cdot}61} = 82$ sq. mm.

(B) *Aluminium.*

Section of core	82 sq. mm.
Weight of all three cores per km. (allow 3 per cent. for stranding) = $82 \times 2{\cdot}7 \times 10^{-3} \times 3 \times 1{\cdot}03$ ...	0·685 tons
Take cost of aluminium wire per ton at £100.	
Cost per km. of 3 × 82 sq. mm. cores	£68
From fig. 3, cost of rest of cable per km.	£400
Total cost of cable per km.	£468

In order that the copper cable should cost £468 per km. copper wire would have to be at £114 per ton.

Or, in order that the aluminium cable should cost only £448 per km., aluminium would have to be at £70 per ton.

TABLE II.—Comparative Costs of Copper and Aluminium Three-Core Cables of Equal Conductivity for Working Pressures of (*a*) 5,000 Volts, (*b*) 10,000 Volts.

Voltage between cores.	Copper.				Aluminium.			
	Section per core.	Price per ton of copper wire.	Total cost of cable per km.	Price per ton of aluminium in order that an aluminium cable may cost the same.	Section per core.	Price per ton of aluminium wire.	Total cost of cable per km.	Price per ton of copper in order that a copper cable may cost the same.
	Sq. mm	£	£	£	Sq. mm.	£	£	£
5,000 volts.	50	77	346	70	82	177	421	131
	121	77	620	72	198	177	792	130
	300	77	1,325	72	492	177	1,758	130
	50	100	378	114	82	40	327	63
	121	100	693	116	198	40	566	62
	300	100	1,515	116	492	40	1,205	62
10,000 volts.	50	100	448	70	82	100	468	114
	100	100	726	68	164	100	767	114
	200	100	1,122	114	328	100	1,084	93

The above results have been incorporated with others in Table II. Particular interest is attached to the figures for the 5,000-volt 121-sq. mm. copper cable, as this corresponds to the cable used to transmit the power from Shepherd's Bush to Notting Hill Gate for the Central London Railway. The cost given in the table of £600 to £700 per km. agrees very well with the actual cost of the cable.*

These results show that, as was the case with low-tension single-core cables, whatever section of core is considered, the price per ton of aluminium corresponding to a given price per ton of copper (*i.e.*, for equal cost of cable) is always the same. In the case of the 200-sq.-mm. core 10,000-volt cable, the variation is caused by the change from circular to sector-shaped cores.

The curves corresponding to the above results are given in fig. 4. Comparing these curves with the curve of fig. 2, we see that for a given price of aluminium wire per ton, copper will have to be at a considerably *higher* price per ton than was the case for low-tension cables, in order that an aluminium cable may be cheaper than a copper cable of equal conductivity. This result confirms the statement on p. 797.

We have, therefore, in fig. 4, a means of determining at once, whether it is an advantage to substitute aluminium for copper for high-tension cables, whatever the current prices per ton of the two metals may be.

For example, if we wish to construct a three-core cable for 5,000 volts working pressure between cores, and with a copper section of 50 sq. mm. per core (or 82 sq. mm.

* See also Electrical Review, Vol. 53, p. 649.

aluminium), supposing aluminium wire to be at £140 per ton, copper wire would have to be at over £115 per ton, in order that any advantage should be gained by substituting aluminium for copper.

There is one exception to the above conclusions, and that is in the case of a very high tension, small copper section cable. The sharp curvature of the very small conductor, as

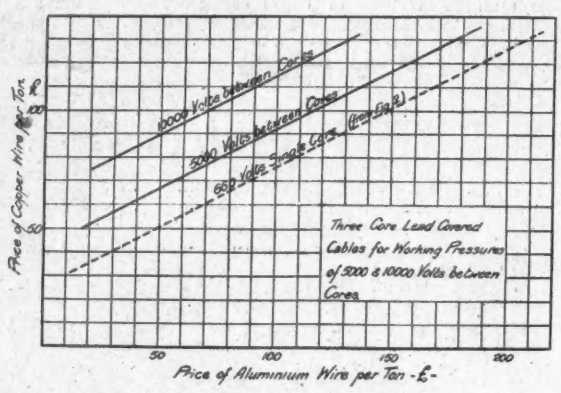
Price of Copper Wire per Ton £
100
50
5000 Volts between Cores
3000 Volts between Cores
600 Volts Single Core (Lead Sheath)
Three Core Lead Covered Cables for Working Pressures of 5000 & 10000 Volts between Cores
50
100
150
200
Price of Aluminium Wire per Ton -£-

Fig. 4.—Curves for Determining which Metal will give the Cheaper Cable for any Market Prices of Copper and Aluminium.

efore mentioned, necessitates an extra thickness of insulation, and in such a case it may be cheaper to use aluminium, even at the present prices of the two metals.

Take, for example,* the exceptional case of a 40,000-volt cable of 50 sq. mm. copper section per core, or 82 sq. mm. aluminium section. The cost of the complete cable (making use of the curve in fig. 3), works out at £1,850 per km. for the copper cable, with copper at £100 per ton.

The cost of the complete aluminium cable works out at only £1,770 per km., with aluminium at £200 per ton.

This is, however, a very exceptional case, and in general it will be found that for *high-tension cables* the copper cable will be the cheaper.

When comparing the relative costs of copper and aluminium cables for an underground system, the possible extra cost of the conduit construction with aluminium cables should also be considered.

The increased diameter of cable may necessitate an increased diameter of duct, but the extra cost thus incurred will probably be very little, and something may be saved on the handling and drawing in of the cables, as they will be considerably lighter in the case of low-tension cables.

Moreover, although the diameter of the aluminium core is 28 per cent. larger than that of the copper core, the total diameter of the aluminium cable will always be considerably less than 28 per cent. larger than that of the copper cable, as the diameter of the core is only some 60 per cent. of the total diameter for low-tension cables, and, of course, much less in the case of high-tension cables.

High-Tension Overhead Lines.—In order to make a comparison between the two metals for this purpose, we have to consider not only the effect of the lower conductivity and consequently larger diameter of an aluminium conductor in comparison with a copper one, but also that of its lower tensile strength and weight.

We can adopt, however, a method for making the comparison between copper and aluminium lines similar to that used when comparing cables: that is, we can express the cost of the line, minus the cost of the conductors themselves, as a function of the section of conductor and the voltage of transmission.

In this case a series of curves will be required for each metal, as the dimensions and strength of the steel towers are dependent not only upon the section of wire, but also upon the physical and mechanical properties of the metal used.

Let us consider the costs of transmission lines for various sections of conductor, but, for the sake of simplicity, all having the following characteristics :—

A single line of steel towers, with concrete foundations, which support six (stranded) conductors fixed on porcelain insulators, and are spaced at a constant distance of 143 m. (470 ft.) apart for all sections of conductor.

A line of this kind represents the most modern practice, and, though costing rather more than a wooden pole line, is more durable and much more satisfactory from an operating standpoint.

In fig. 5 are given curves of the cost per km. of steel towers, insulators, &c., and erection for both copper and aluminium lines having the above characteristics.

In order to show the use of these curves, let us estimate the approximate cost of a 60,000-volt transmission line, consisting of two three-phase circuits, *i.e.*, six conductors, each conductor of 50 sq. mm. section for copper or 82 sq. mm. section for aluminium.

(A) *Copper.*

Section per conductor	50 sq. mm.
Weight of all six conductors per km. (allow 2 per cent. for stranding) $50 \times 8{\cdot}9 \times 10^{-3} \times 6 \times 1{\cdot}02$ ...	2·73 tons
Cost of six conductors per km., copper wire at £77 per ton = 2·73 × 77	£210
From fig. 5, cost of line per km.	£340
Total cost of line per km.	£550

(B) *Aluminium.*

Section of conductor	82 sq. mm.
Weight of all six conductors per km. (allow 2 per cent. for stranding) $82 \times 2{\cdot}7 \times 10^{-3} \times 6 \times 1{\cdot}02$ ...	1·36 tons
Cost of six conductors per km., aluminium wire at £177 per ton = 1·36 × 177...	£240
From fig. 5, cost of line per km....	£370
Total cost of line per km.	£610

Consequently for these particular sections of conductor, spans, and prices of the two metals, a copper line will be the most economical.

Returning again to fig. 5, it will be noticed that for conductors of 50 sq. mm. section, the cost of the line, minus

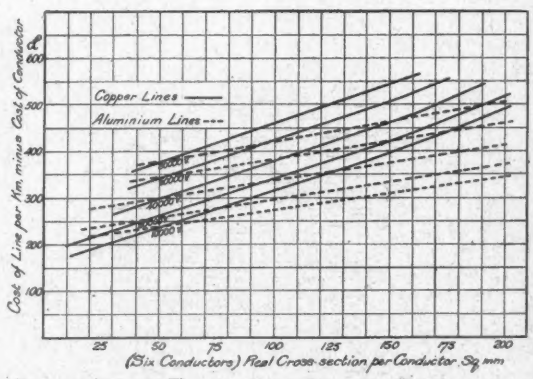

Fig. 5.—Cost of Towers, Insulators and Erection for Three-Phase Duplicate Circuit Transmission Lines.

the cost of the conductors, is the same whether copper or aluminium is used.

The character of the aluminium line will be somewhat different to that of the copper line, however; the towers in the former case will be higher (on account of the larger maximum sag* of the aluminium wires), but on the contrary, the towers for the copper line will be somewhat heavier, so that the costs of the two lines will be about equal.

Much is often made of the fact that the towers have to support only *half* the weight of conductors, if aluminium is substituted for copper.

This is quite true, but the effect, due to this fact, on the necessary strength, and consequently the cost, of the towers is quite offset by the effect due to the other facts—that the larger diameter of the conductor and the extra height of tower both mean an increase in the stresses in the tower members due to wind pressure, and that the increased height of tower means itself a more expensive tower.

For larger sections, the aluminium line is the cheaper, for smaller sections the copper line is the cheaper on account of the very large sag of the aluminium conductors.

* See also the paper by W. M. Morrison, *Journal I.E.E.*, Vol. XXXI, p. 411.

* The larger sag is accounted for by the lower permissible stress and the higher coefficient of expansion for aluminium.

However, if we compare the costs of the line construction minus the cost of the conductors for *equal conductivities*, we find that the lines will cost about the same for sections per conductor of 100 sq. mm. and 164 sq. mm. for copper and aluminium respectively. Above these sections, the aluminium line for equal conductivity will be the cheaper, below these sections the more expensive, for the particular span and construction considered.

There are lines in America where the stranded aluminium conductor has a total section of 320 sq. mm., and the construction is similar to that assumed above. The approximate cost of such a line can be easily estimated by extending the curves of fig. 5.

Thus we see that, for equal conductivities and for such prices of the two metals as cause the conductors, for equal conductivities, to cost the same *(i.e., when the price per ton of aluminium wire is just double the price of copper wire), an aluminium overhead line will cost about the same as a copper line. If aluminium is cheaper than copper for equal conductivity, an aluminium line will generally be the most economical.*

Line Constants.—Before concluding this investigation, it will be as well to add a few words concerning the relative effects of capacity, inductance and what is known as the "skin effect" for copper and aluminium conductors.

As aluminium is one of the non-magnetic metals, we have to consider only the effect of the larger diameter.

The expression for the capacity of a length of line contains the logarithm of the value of the diameter of the conductor in the numerator, consequently the larger diameter of an aluminium conductor means a slight increase in capacity.

On the other hand, the expression for the inductance of a circuit contains the logarithm of the value of the diameter of the conductor in the denominator, consequently the inductance will be slightly decreased where aluminium is substituted for copper.

In both cases the difference is small, about 5 per cent. increase and decrease respectively, but as all transmission lines possess an excess of inductance over capacity, this difference is in favour of an aluminium line, as the power factor will be slightly better.

Skin Effect.—Lastly, let us consider the value of the increase in resistance to alternating current, the "skin effect." For non-magnetic metals and for a given frequency, this increase in resistance is directly proportional to the section of the conductor and inversely proportional to the conductivity.

Consequently, for solid conductors of various non-magnetic metals of such sections as to give equal conductivity, this increase in resistance will be the same for all. Thus the "skin effect" for a solid aluminium conductor will be the same as that for a solid copper conductor of equal conductivity.

If the conductor is stranded, however, this is not the case, as the section of the strand, and not the total section, is the factor to be considered.

Aluminium cables are generally made up of strands of approximately the same diameter as that of those in a copper cable of equal conductivity, but a larger number of strands are employed.

Consequently the increase in resistance due to skin effect will be *smaller for the aluminium cable* in this case. Although the skin effect is negligible for the usual sections and frequencies employed, it is as well to know that the use of aluminium does not either materially increase or decrease this effect.

Conclusions.—The results of the above investigation point to the following conclusions:—

1. That aluminium may be expected to compete very favourably with copper for use in low-tension cables, but that for use in high-tension three-core cables, the price of copper will have to be abnormally high, or the price of aluminium abnormally low in order that the aluminium cables may show to any advantage.

2. That aluminium has every chance of becoming even more widely used than copper for overhead work.

In conclusion, the author wishes to state that these investigations have been carried out by him in the office of Mr. H. M. Hobart, and in accordance with his instructions. The present article, embodying the main results of the investigation, has been written by the author at the request of Mr. Hobart.

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Electro-Chemical Notes.—AN IMPROVED ELECTRIC FURNACE.—An American patent has recently been taken out by M. P. T. Héroult for the form of electric furnace which was apparently used by the inventor during his last experiments on the electrical smelting of steel at Sault St. Marie, in Ontario, Canada. The improvements claimed are two-fold. In the first place, the base of the furnace consists of a mass of carbon erected on a cast-iron bedplate, the cast-iron itself having been cast round a number of upstanding iron rods with divided points which penetrate into the carbon. The object of this arrangement is to decrease the resistance between the cast-iron and the carbon mass, and it is stated that the result is a reduction of about 2 per cent. The second improvement consists in breaking at one or more places the sheet-iron cylinder within which the furnace is built an insulating in the break, or breaks, vertical plates of copper riveted to the iron. The object of interrupting the ring of iron in this fashion is to introduce a non-magnetic material into the casing of the furnace, so as to prevent the formation of a magnetic ring round the axis of the current. The presence of a magnetic ring round a furnace has been found to introduce numerous defects, and the plan adopted by Héroult is stated to increase the efficiency of the furnace from about 60 to 90 or 93 per cent.

THE RESISTIVITY OF ELECTRODES.—In a recent issue of "Liebig's Annalen der Chemie" appears an article by Herr W. Muthmann and several collaborators upon methods for preparing rare earth metals and their employment, in the course of an appendix to which the properties of numerous varieties of electrodes are discussed. The authors state that Acheson graphite is distinguished by its great purity, and its power of resisting the attack of fused salts, chlorine, fluorine, and oxygen. The material can easily be worked up, and can be cut with a knife, sawn, or filed. Gas retort graphite is fairly capable of resisting chemical attack, but is extremely difficult to work up. These varieties of graphite have the advantage of possessing a much lower resistivity at high temperatures. The carbons prepared by Siemens have the unpleasant property of disintegrating rapidly. The carbons made by Lessing, of Nuremberg, do not disintegrate and are very pure. When examined by Schmidt, of Munich, these and other electrodes gave the following electrical resistance per square millimetre × metre:—

	Resistivity in Ohms. Cold.	Hot.
Acheson graphite...	37·45	14·06
" "	21·90	16·56
Siemens carbon	54·73	56·88
Lessing carbon	52·92	49·96
Retort graphite	46·11	47·52
Ceylon graphite	56·84	6·29
Silicon	472·66	183·14
"	503·00	194·01

ELECTRO-CHEMICAL INDUSTRIES AT LYONS.—According to a recent report, the various electro-chemical and electro-metallurgical industries which exist in the neighbourhood of Lyons developed considerably during 1906, and it is now intended to procure further water-powers for their exploitation, falls on the slopes of the Pyrenees being utilised as well as others in the valleys of the Alps. The total amount of power used in the manufacture of chemicals, &c., is stated to have been 100,000 H.P., the production of aluminium absorbing 35,000, that of calcium carbide 25,000, and that of potassium and sodium chlorate 15,000. The steel prepared electrically required 22,000 H.P., the manufacture of soda, chlorine and bleach took 1,000 H.P., and 2,000 H.P. were employed for various unspecified purposes.

DANGERS INCIDENTAL TO COAL STORAGE IN CENTRAL STATIONS.

By A CENTRAL STATION MAN.

It is an increasing practice in our larger electricity generating stations, in view of the highly efficient steam-raising plant now available, to utilise large quantities of small and dirty coal on the perfectly correct hypothesis that it pays better to burn a somewhat larger amount of poor and dirty coal, than to buy the best coal of a high calorific value at an enhanced price. When one reads, however, of the disastrous explosions in coal mines from coal dust, a serious doubt arises in one's mind as to whether we are taking sufficient precaution in the storage of large quantities of small and dirty coal in the bunkers of our power stations, more especially as such bunkers are not very largely sub-divided, and trouble occurring in any particular part of the coal may easily extend to the whole storage of the fuel. The practice of storing coal over the boiler room in a long, low, and often not too well ventilated bunker, is quite a common thing. The coal, which is generally in the form of peas or nutty slack, falls from a conveyer into pen bunkers or direct into the hopper slits, and the air at times is so dense with coal dust that there is no doubt that a match carelessly struck in the midst of this dust would cause a similar explosion to that which from time to time occurs underground, quite apart from the danger of spontaneous ignition.

Cases of fires in bunkers are by no means rare, and are commonly caused either by spontaneous combustion or by heat, owing to the fact that the coal is being stored against hot boiler or flue walls. If a large quantity of coal is bunkered in wet weather and shot on to a heap or into a narrow deep bunker, it will, if in the form of small slack or peas, be almost sure to heat, and should, if likely to be unused for any length of time, be probed with a stick every day to see whether it is heating or not.

A case occurred some years ago in a large power station where some thousands of tons of coal were destroyed in this manner. The coal was shot when wet into four square deep 250-ton pen bunkers, the floor of which was always hot from being immediately over the boilers. The inevitable result followed, and as the coal when found was well alight in the centre and bottom of each bunker, it was impossible to take it out, as it broke into flame immediately the air got at it. The only thing to do was to continuously soak the heaps with a water hose, and for five weeks this coal smouldered until it was entirely coked and spoiled. When it was finally cleared out the iron floors of the bunkers were found to be badly burned at the bottom, and the back end of the bunker room was seriously cracked and bulged.

Another case occurred where a few tons of coal were tipped against the side of a Babcock & Wilcox boiler, which was at the time under steam, in a direct-current station which shut down at midnight. At 7 a.m. the boiler-house roof was seen to be on fire; the heat from the boiler had fired the coal. The fire had travelled through a heap of about 10 ft. in the few hours intervening, and set fire to the temporary end of the boiler-house, which consisted of wood and galvanised iron.

It will be seen from the above notes that the class of coal so commonly used nowadays with mechanical stokers is undoubtedly a source of danger in storage, and much greater care should be exercised in bunkering these coals than is needed with the larger varieties.

A Roumanian Amalgamation.—An amalgamation is being arranged of the Roumanian companies, Electria and the Uzina Sinaia, which were both originally founded by the Lahmeyer Electricity Co., of Frankfort-on-Main. The fusion takes the form of the absorption of the Uzina Sinaia by the Electria Co., which assumes the assets and liabilities of the former, and issues to the shareholders in that undertaking new shares in the Electria Co. of the value of £100,000. The capital of the latter company is being increased by this amount for the purpose.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Automatic Boiler-Feeding.

The arrangement here described was published in the *Zeitschrift für Dampfkessel und Maschinenbetrieb* for the 15th inst.; it is intended automatically to maintain the water-level constant in a working steam boiler. The auxiliary apparatus shown in fig. 2 is designed to divert the feed-water back to the storage tank when normal level is attained; but the controlling device shown in fig. 1 could easily be adapted to the control of the motor or engine driving the pumps themselves.

The controller is bolted to the boiler-shell *d* at normal water-level, and contains a float *c c*, to which is attached a valve *b* closing the end of the pipe *a* when the water-level is low. Steam is thus

Fig. 1.

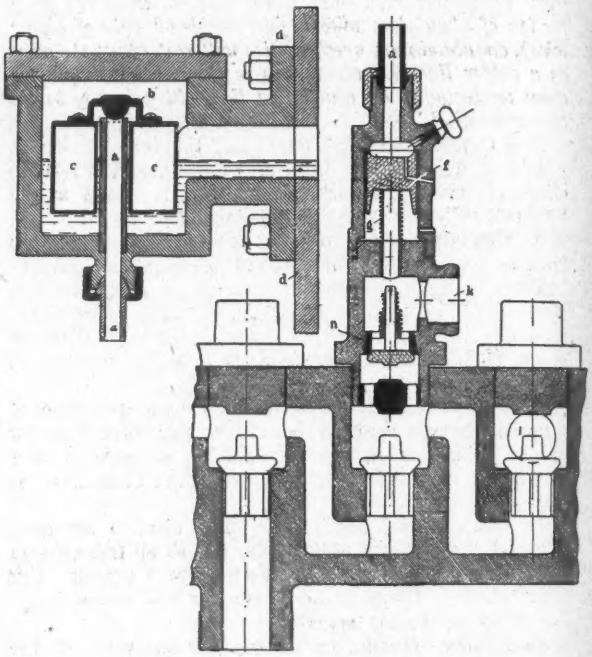

Fig. 2.

cut off from the device shown in fig. 2, which may be fixed in any convenient position. So long as the steam has access to the pipe *a*, the piston *f* is pressed down, thereby opening the valve *n* and allowing the feed-water to be by-passed through *k* to the storage tank. But when steam is cut off from *a* by the fall of the water-level, the spring *g* lifts the piston *f*, allows a spring to close valve *n*, and thus compels the feed-water to pass into the boiler by way of the passage *l* until the normal water-level is restored.

Electric Lighting in the City.

In addition to the Gilbert arc lamps installed by the Charing Cross, West End and City Co. in Cannon Street, described in our last issue, 25 "Oriflamme" arc lamps made by the Oliver Arc Lamp, Ltd., of Cambridge Place, Burrage Road, Woolwich, have been installed by the City of London Electric Lighting Co. in Holborn. It is claimed on behalf of the "Oriflamme" that it burns without change of colour and candle-power when feeding.

The accompanying illustrations, on p. 875, show the mechanism of the lamp. Figs. 1 and 2 show vertical sections of the lamp; fig. 3 is a detail view of one of the magazines, and fig. 4 is a diagram of connections.

The magazines hold 6 to 10 pairs of carbons, which are placed on the opposite sides of the lamp case. The magazine containing the negative carbons is fixed, and the positive magazine is pivoted so that it can be swung away from the other for the purpose of striking the arc. The movements of this striking magazine are controlled by the differential solenoid. The carbons have the usual V arrangement. In order to feed down and to change the pairs of carbons, there is at one side of the magazine a narrow slot, working against the face of which is an endless chain of special construction, passing over toothed wheels pivoted near the top and bottom of the magazine. The outside face of the chain carries at definite intervals a projecting pip which travels down the slot in the side of the magazine, and in its path are placed the upper ends of the particular carbons which form the burning pair. Each magazine has a chain as described, and both are worked simultaneously from a large-diameter toothed wheel. The pawl engaging with this wheel is pulsated electrically by a small magnet in the upper portion of the lamp, and the circuit of this coil is closed by a special form of mercury switch which is racked backwards and forwards by the controlling solenoids and also by the armature of the small coil just referred to. The mercury is sealed in a glass

tube from which the air has been exhausted, and two small electrodes which close the circuit of the racking coil are sealed in the tube, one at each end. The tilting of the tube causes the mercury to close the circuit, thereby giving a series of impulses to the pawl and to the carbon-conveying chains. The racking down of the carbons goes on at regular intervals, and when a pair is burnt out the ends are discharged into an ash-tray at the bottom of the globe, and a new pair is immediately moved into position. The changing of the carbons occupies about 20 seconds, during which period, of course, the lamp is extinguished. Special attention has been paid to the ventilation of the globe and the lamp-case; the former is a most important point in flame lamps, as, in order to

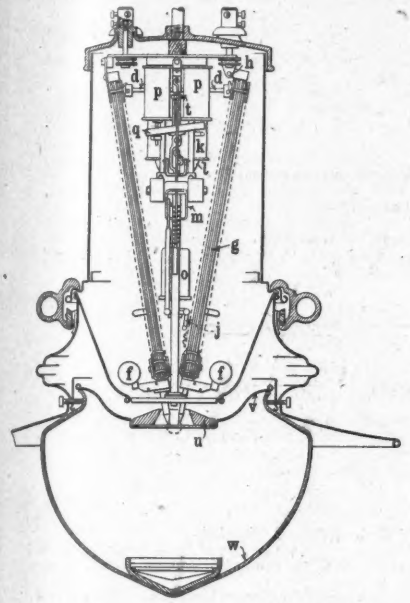

Fig. 1.

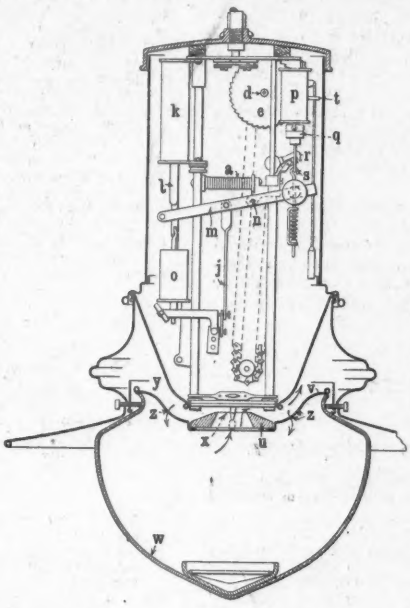

Fig. 2.

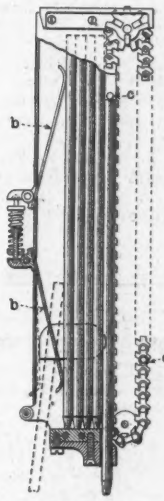

Fig. 3.

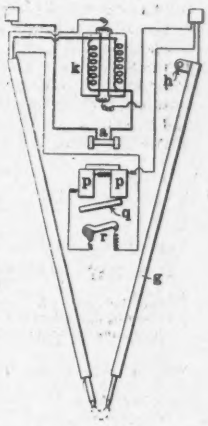

Fig. 4.

Index to Parts:—*a*, Blow magnet; *b*, Carbon springs; *c*, Carbon-carrying pips; *d*, Ratchet-wheel spindle; *e*, Ratchet wheel; *f*, Magazine balance weights; *g*, Magazine; *h*, Hinge for magazine; *j*, Dashpot link; *k*, Control solenoids; *l*, Control solenoid plunger; *m*, Rocking lever; *n*, Rocking lever fulcrum; *o*, Dashpot; *p*, Racking solenoids; *q*, Racking armature; *r*, Mercury switch; *s*, Rocking-lever link; *t*, Pawl rod; *u*, Intensifier; *w*, Globe; *x*, Carbon tips and arc; *y*, Dust chamber; *z*, Removable spinning.

Mechanism of the "Oriflamme" Arc Lamp.

obtain the highest efficiency, as much of the fumes as possible must be prevented from depositing on the interior of the globe; and in the "Oriflamme" lamp there is a special chamber provided above the reflector and between it and the mechanism, in which the dust and other deposits collect. The removable metal copper spinning of conical shape is provided to form the chamber, and as the bulk of the deposit settles on this it can be easily wiped off. The interior mechanism of the lamp is not sealed off from the arc gases, but these have no effect on the burning or the operation of the controlling mechanism. In the latter, wherever possible, knife-edges are employed for all bearings, and the lamps will run quite steadily, even if heavily coated with deposit. The construction of the lamp is such that any part is easily accessible, and the dash-pot, which is really the only part of the lamp that requires periodical attention, is made with a bayonet socket so that it can be easily taken out for cleaning without removal of the outside lamp casing.

One particular advantage of the "Oriflamme" lamp is that a great number can burn on a circuit; for instance, 12 lamps would burn on a 460-volt D.C. circuit with a standard consumption of 9 amperes, representing a consumption of about one-third of a kilowatt per lamp, and this lamp will give a mean hemispherical candle-power of 1,200 with globe on and taken under ordinary working conditions. Either yellow or white-flame carbons may be used in the "Oriflamme" lamp, the latter, however, being somewhat more expensive. The cost of the carbons is very low, and about one-third the cost of those generally employed.

The "Oriflamme," which is of British invention and manufacture throughout, is largely in use for street lighting, and the makers have just received a repeat order from the Bristol Corporation for 128 lamps, both alternating and continuous current.

THE NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF AMERICA.

Members of the various sections of the Electrical Contractors' Association in London and the provinces, and, no doubt, the large number of other electrical contractors who are not associated with these bodies, will be interested to read what is being done by a similar organisation which is in existence in the States. An account written by Mr. W. H. Morton, the Secretary of the American Association, reprinted from a recent number of the New York *Electrical Record*, appears below. It may be interesting to remark that the trans-Atlantic organisation was got into shape a little after the movement had got into swing in this country:—

The National Electrical Contractors' Association was organised in July, 1901, at a meeting of electrical contractors called by the New York State Contractors' Association. This meeting was attended by representatives of the contracting interest from all parts of the country, and a discussion of the trade conditions made it evident that a national organisation was needed.

The objects of the Association, broadly stated, are to improve the conditions of the electrical construction business throughout the country. The contractors fully appreciated the necessity of concerted action to correct abuses in the trade, and realised that this work could be done only by an association that was national in its character.

One of the most important subjects connected with the electrical construction business is the question of rules governing the installation of work, and proper inspection of such work to secure the enforcement of the rules. The National Association appointed a committee immediately after its formation to take up this subject. This committee secured the privilege of representation at the meetings of the Underwriters' National Electric Association, and membership in the National Conference on Standard Wiring Rules, thus giving the contractors a voice in the consideration of changes in the National Electrical Code.

The organisation feels that a constant effort should be made to raise the standard of electrical construction, to secure the strict and impartial enforcement of wiring rules, and to arrange for the uniform interpretation of the rules in all sections of the country. The committee has worked with these objects in view and has accomplished a great deal that is of benefit to the contracting trade and to the general public.

The Association believes that electrical wiring properly installed, forms the safest method of transmitting energy for light and power, but it also recognises that electrical work improperly installed is a menace to life and property. For this reason it believes that the State authorities should pass laws safe-guarding the installation of such work, and making the contractor responsible for defective installations.

This can be accomplished by a law that provides for the licensing of all electrical contractors after they have passed an examination, demonstrating their ability to properly install electrical work, and by requiring all licensed contractors to furnish a bond conditioned on the satisfactory performance of their work. Much has been done by the National Committee along this line, and satisfactory laws are now in force in several States, and are being advocated in many others.

One great source of misunderstanding and annoyance in the electrical construction business, has been the lack of uniformity in the symbols or characters used on plans to designate the different classes of electrical wiring, fittings and outlets. Feeling that this caused inconvenience to contractors, architects, engineers, and owners, the National Association appointed a committee to draft a uniform set of symbols that would cover the different classes of wiring commonly used. This committee, after consulting with prominent architects and engineers, prepared a set of symbols that was simple and comprehensive, and it is urging the universal adoption of these. The Association has distributed copies of these symbols to practically all architects, engineers and contractors in the country, and believes that their use will save much time and confusion.

The electrical business, on account of its exceedingly rapid growth, seems to have developed along lines that are not in accordance with the usual laws of trade. On account of this rapid development, the manufacturers were forced to sell their products through their own efforts direct to the consumer, until the jobbing interests developed sufficiently to take their proper position in the trade. The continued increase in business practically forced the jobber to act as a retailer also, and deal directly with the consumer.

The National Association believes that the contracting business has now developed to a point where the electrical contractors should be recognised as the legitimate retailers of electrical goods, and that the business should follow the established laws of trade, the manufacturer selling to the jobber, the jobber to the contractor or dealer, and the contractor distributing the goods to the consumer. The aim of the Committee of the National Association that has worked on this subject has been to bring about this change.

The National Electrical Contractors' Association stands ready to take up through its committees any question that affects the interests of the trade. It has already accomplished a great deal, and has raised the standard of electrical construction work, but it fully realises that its work has only begun.

The organisation stands for high-grade work, honest business methods, and better trade conditions, and on this platform asks the support of every electrical contractor in the country, who is interested in raising the standard of the electrical construction business, feeling sure that it is a well-understood fact that, under the existing business conditions, better conditions can be brought about only through organised effort.

NEW PATENTS APPLIED FOR, 1907.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

8,023A. "Improvements in the means of propulsion of electrically-driven trains and the like." S. Stone and L. W. Migotti. (Date applied for under Rule 5 of the Patents Rules 1905, April 13th, 1907). November 6th.

24,356. "Improvements in battery coil and sparking plug testing machines." E. Bristowe and G. Henman. November 4th.

24,363. "Improvements in switching devices, specially applicable for use in controlling the electric lamps employed in flashing or revolving lights or for advertising purposes." W. B. Prince. (Dr. P. Meyer, A.G., Germany.) November 4th. (Complete.)

24,364. "Improvements in or in connection with control of electric motors." A. K. Baylor. November 4th.

24,387. "Improvements in apparatus for recording bell or like signals specially applicable to mines." J. Russell and J. H. Milligan. November 4th. (Complete.)

24,414. "Improvements in automatic railway signals." J. P. Norwood. November 5th. (Complete.)

24,461. Improvements in contact-breakers or tremblers for induction coils." S. S. Everett. November 5th.

24,486. "Improvements in electrodes." W. Hagen. November 5th.

24,505. "Improved device for electrically connecting electric wires and other conductors, also applicable for other purposes." W. Scheffler and W. Schumacher. November 5th. (Complete.)

24,517. "Improvements in and relating to processes of melting in electric furnaces and their application to the extraction of easily volatisable metals." H. Herrenschmidt. (Date applied for under Patents Act, 1901, November 9th, 1906, being date of application in France.) November 5th. (Complete.)

24,546. "Improvements in or in connection with resistances for regulating electric current." N. R. Booth. November 6th.

24,550. "Improvement in electric radiators and other apparatus where banks of massed lamps or other radiating devices are used." W. Fennell and W. P. Perry. November 6th.

24,567. "Magnetic couplet to be worn on the finger, or on or in proximity with other parts of the body, for the alleviation of rheumatism and for other curative purposes." E. Brown and J. Cameron. November 6th.

24,579. "Improvements in and relating to sparking plugs for internal combustion engines." W. Wrentmore Stanton. November 6th.

24,580. "Improvement in the construction of electric heaters and resistances." H. R. Broughton and G. H. Alderton. November 6th.

24,587. "Improvements in or relating to flexible electrical connection devices and the like." C. A. Keller. November 6th. (Complete.)

24,589. "Improvements in or connected with protective devices for electric circuits." F. Pooley and W. R. Macdonald. November 6th.

24,635. "Improvements in arc lamps." W. A. Legge. November 7th.

24,647. "Improvement in section insulators for tramway trolley wires." R. Cunningham. November 7th.

24,670. "Arrangements on electricity meters for determining the maximum consumption." Elektricitäts-Akt.-Ges. vorm Schuckert & Co. (Date applied for under Patents Act, 1901, November 20th, 1906, being date of application in Germany.) November 7th. (Complete.)

24,671. "Arrangements on electricity meters for determining the maximum consumption." Siemens Schuckertwerke G.m.b.H. (Date applied for under Patents Act, 1901, November 8th, 1906, being date of application in Germany.) November 7th. (Complete.)

24,702. "Improvements in or relating to automatic electrical fire-alarm circuits." O. Rennert. November 7th. (Complete.)

24,706. "Improvements in electric arc-lamps." Johnson & Phillips, Ltd., and C. F. Tubbs. November 7th. (Complete.)

24,707. "Improvements in refractory electric conductors." British Thomson-Houston Co., Ltd. (General Electric Co., United States.) November 7th. (Complete.)

24,723. "Improvements in igniting lamps or gas lighting devices." H. H. Clayton. November 8th.

24,751. "Improvements in or relating to commutators for dynamo-electric machinery." Siemens Schuckertwerke G.m.b.H. (Date applied for under Patents Act, 1901, November 12th, 1906, being date of application in Germany.) November 8th. (Complete.)

24,758. "Improvements in means for rectifying alternate currents." Siemens Bros. & Co., Ltd. (Siemens & Halske Actiengesellschaft, Germany.) November 8th. (Complete.)

24,769. "Improvements in insulated rail joints." B. Wolhaupter. (Date applied for under Patents Act, 1901, November 8th, 1906, being date of application in United States.) November 8th. (Complete.)

24,770. "Improvements in insulated rail joints." B. Wolhaupter. (Date applied for under Patents Act, 1901, November 8th, 1906, being date of application in United States.) November 8th. (Complete.)

24,779. "Improvements in and relating to telephonographical apparatus." S. Wertheimer and J. Beer. November 8th.

24,781. "Improvements relating to electric conductors for use in connection with installations of electric light." G. Davis. November 8th.

24,784. "Improvements relating to dynamo-electric machines." S. Pinkus. November 8th.

24,792. "Improved magnetic compass." S. S. Lawrence. November 8th. (Complete.)

24,802. "Improvements in apparatus for transforming electric currents." D. Timar and K. von Dreger. (Date applied for under Patents Act, 1901, March 21st, 1907, being date of application in Germany.) November 8th. (Complete.)

24,807. "Electric furnace." E. A. O. Viel. November 8th. (Complete.)

24,808. "Improvements in and relating to alternating current dynamo-electric machines." British Thomson-Houston Co., Ltd. (General Electric Co., United States.) November 8th.

24,813. "Improved filament for electric glow lamps." J. W. Ward and R. H. Stevens. November 9th.

24,862. "Improved integrating train for double-tariff electric energy meters." V. Arcioni. November 9th. (Complete.)

24,874. "Improvements in and relating to electric conductors." P. Richardson. November 9th. (Complete.)

24,877. "Improvements in apparatus for opening and closing electric circuits at predetermined times." J. Gunning. November 9th.

24,879. "Improvements in or in connection with the control of electric motors." A. K. Baylor. November 9th.

24,894. "Improvements in electricity measuring instruments." T. E. Slaughter and H. T. Harrison. November 9th.

24,896. "Improved method of signalling by night for mercantile marine and the like." J. A. Cox. November 9th.

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool price, post free, 9d. (in stamps).

1906.

Electric Batteries. H. F. Joel. 22,547. October 12th.

Method and Means for Sealing Electric Conductors in or through Glass or like Vitreous Material. C. O. Bastian and G. Calvert. 22,911. October 16th.

Method and Means for Sealing Electric Conductors in or through Glass or like Vitreous Material. C. O. Bastian and G. Calvert. 22,911A. October 16th. (Date applied for under Rule 5 of Patents Rules 1905, October 16th, 1906.)

Application of the Surface Contact System of Electric Traction. R. Brown. 23,094 October 18th.

Submarine Cable Telegraphy. S. G. Brown. 23,251. October 19th.

Construction and Application of Direct-Current Electric Motors. Felten and Guilleaume Lahmeyerwerke Akt.-Ges. 23,256. October 19th. (Date applied for under International Convention, October 19th, 1905.)

Telegraphy. I. Kitsee. 23,385. October 22nd.

Electrical and Clockwork Advertising Novelties. H. Pye. 23,467. October 23rd.

Telephone Circuits. C. M. Jacobs. 23,519. October 23rd.

Instrument for Measuring and Gauging Arc Lamps, Carbons and the like. C. Richter and H. Haser. 23,854. October 26th.

Ears or Supports for Suspending Electric Trolley Wires. R. E. Dixon and A. E. Dodwell. 24,390. November 1st.

Vibratory Controlling Devices for Induction Coils and the like. P. M. Justice. (Orswell Igniter Co.) 26,933A. November 27th. (Date applied for under Rule 5, Patents Rules 1905, November 27th, 1906.)

Construction of Core Grid for Direct and Alternating Electric Current Machines. W. Deacon. 28,192. December 11th.

Railway and Like Signalling Systems and Apparatus Therefor. British Thomson-Houston Co. (C. J. Kintner.) 29,204. December 21st.

Method of and Means for Automatically Recording Telephone Calls. H. W. F. Ireland and A. T. M. Thomson. 29,296. December 22nd.

1907.

High-Tension Magneto-Electric Ignition Apparatus. G. A. Unterberg and F. Helmle (trading as the firm of Unterberg & Helmle). 3,381. February 11th.

Method of Amplifying the Feeble Energy effects of Electric Waves and Apparatus therefor. R. A. Fessenden. 4,715. February 26th.

Combined Portable Telephone and Telegraph Instrument. R. W. Medhurst. 5,209. March 4th.

Method of Producing Electrical Oscillations. S. Eisenstein. 5,354. March 5th.

Dynamo-Electric Machines Provided with Commutating Field Coils. H. F. T. Erben. 5,866. March 11th. (Date applied for under International Convention, January 16th, 1907.)

Means for Indicating when Conductors of Electrical Energy are Charged or in Live Condition. H. J. Gridley. 6,890. March 16th.

Arc Furnaces for the Electrical Treatment of Gases. Salpetersaure-Industrie Ges. 7,320. March 27th. (Date applied for under International Convention, July 6th, 1906.)

Electric Telegraphs. Siemens Bros. & Co. and G. S. Grimston. 7,443. March 28th.

Electric Resistance Element. W. Boult. (W. Hoskins, U.S.A.) 8,359. April 10th.

Electro-Plating Solution. R. H. Marshall. 8,560. April 12th.

Process for Increasing the Durability of Carbon and Graphite Electrodes in Aqueous Solutions. Chemische Fabrik Buckau. 9,637. April 25th. (Date applied for under International Convention, May 8th, 1906.)

Systems of Insulation for High Potential Electric Conductors. F. M. Locke. 10,694. May 8th.

Telephone Transmitters. W. G. Heys. (General Acoustic Co.) 11,754. May 21st.

Magneto-Electric Ignition Apparatus. W. Roos. 12,185. May 25th.

Electric Typewriters. J. Lemble. 12,150. May 25th. (Date applied for under International Convention, May 25th, 1906.)

Inverted Incandescent Vapour Lamps. E. Kothe. 12,642. May 31st.

Electrical Signalling Installations Constantly Fed with Current. Siemens Bros. & Co. (Siemens & Halske Akt.-Ges.) 13,349. June 8th.